Coastal Hazardous Waste Site REVIEWS

September 1995

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Coastal Hazardous Waste Site

REVIEWS

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Contents

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Introduction

This report identifies uncontrolled hazardous waste sites that could pose a threat to natural resources for which the National Oceanic and Atmospheric Administration (NOAA) acts as a trustee. NOAA carries out responsibilities as a Federal trustee for natural resources under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan. As a trustee, NOAA identifies sites that could affect natural resources, determines the potential for injury to the resources, evaluates cleanup alternatives, and carries out restoration actions. NOAA works with the U.S. Environmental Protection Agency (EPA) to identify and assess risks to coastal resources from hazardous waste sites, and to develop strategies to minimize those risks.

NOAA regularly conducts evaluations of hazardous waste sites proposed for addition to the National Priorities List[1] (NPL) by EPA. The waste sites evaluated in this report are drawn from the list of all sites, including Federal facilities, proposed for inclusion on the NPL in Update 15.

The sites of concern to NOAA are located in counties bordering the Atlantic Ocean, Pacific Ocean, and Gulf of Mexico, or are near inland water bodies that support anadromous fish populations. Not all sites in coastal states will affect NOAA trust resources. To select sites on the National Priorities List for initial investigation, only sites in coastal counties or sites bordering important anadromous or catadromous fish habitat are considered to have potential to affect trust resources. This initial selection criterion works better in some states than in others. It depends on topography, hydrography, and the nature of political subdivisions.

These reports are an overall guide to the potential for injury to NOAA trust resources resulting from a site. NOAA uses this information to establish priorities for investigating sites. Sites that appear to pose ongoing problems will be followed by a NOAA Coastal Resource Coordinator (CRC) in the appropriate region. The CRC communicates concerns about ecological impact to EPA, reviews sampling and monitoring plans for the site, and helps plan and set objectives for remedial actions to clean up the site. NOAA works with other trustees to plan a coordinated approach for remedial action that protects all natural resources (not just those for which NOAA is a steward). Other Federal and state trustees can use the hazardous waste site reports to help determine the risk of injury to their trust resources. EPA uses the site reports to help identify the types of information that may be needed to complete an environmental assessment of the site.

These coastal site reports are often NOAA's first examination of a site. Sites with potential to impact NOAA resources may be followed by a more in-depth Preliminary Natural Resource Survey (PNRS), detailed assessments of potential injury to environmental receptors. PNRSs may also be used earlier in the process to document the rationale for adding a site to the National Priorities List.

Ten coastal sites were identified in August 1995 using this selection method and coastal hazardous waste site reports completed for them. A total of 276 coastal hazardous waste sites have been reviewed by NOAA since 1984 (published in April 1984[2], June 1985[3], April 1986[4], June 1987[5], March 1989[6], June 1990[7], September 1992[8], December 1993[9], June 1995[10], and this report). A total of 123 PNRSs have been conducted since 1988 (see table below). The current reporting brings the total number of sites considered by NOAA to 579.

Year	NPL Reports	PNRSs
1984	70	
1985	19	
1986	14	
1987	32	
1988		17
1989	70	31
1990	24	32
1991		15
1992	8	14
1993	18	7
1994		1
1995	21	2

The 1995 coastal hazardous waste site reviews contain four major sections. "Site Exposure Potential" describes activities at the site that caused the release of contaminants, local topography, and contaminant migration pathways. "NOAA Trust Habitats and Species" describes the types of habitats and species potentially injured by releases from the site. The life stages of organisms using habitats near the site are discussed, as are commercial and recreational fisheries. "Site-Related Contamination" identifies contaminants of concern to NOAA, the partitioning of the contaminants in the environment, and the concentrations at which the contaminants are found. "Summary" cogently recaps this information.

Tables and Screening Values

Most of these reports contain tables of contaminants measured at the site. These tables were formulated to highlight contaminants that represent a potential problem, and to focus our concerns on only a few of the many contaminants normally present at a waste site. Data presented in tables were screened against standard comparison values, depending on the media of the sample. Screening values used are ambient water quality criteria[11], selected soil averages[12], and Effects Range Low (ERL) values[13]. Because releases to the environment from hazardous waste sites can span many years, we are concerned about chronic impacts. Therefore, we typically make comparisons with the lower standard value (e.g., chronic vs. acute AWQC).

There is very little information regarding the toxicity of contaminated soil or sediment. No criteria similar to the AWQC are available. Thus, sediment concentrations were screened by comparison with the ERL reported by Long and MacDonald[13]. The ERL value is the concentration equivalent to that reported at the lower 10-percentile of the screened sediment toxicity data. As such, it represents the low end of the range of concentrations at which effects were observed in the studies compiled by the authors. Although freshwater studies were included, predominantly marine and estuarine toxicity studies were used for generating ERL values.

Soil samples were compared to selected average levels from Lindsay (1979) as reported by EPA in 1983 in *Hazardous Waste Land Treatment.* These values were averaged from a data set (selected by Lindsay) from soil throughout the entire U.S. Ideally, reference values for soil would be calculated on a regional basis, from a data set large enough to give a value representative of the area. In the absence of such data, the values from Lindsay were used as a reference for comparison purposes only.

All of the hazardous waste sites considered by NOAA in this review are contained in the Table of Contents, including the name and location of the site and the beginning page number of the site report. Table 1 lists all of the sites at which NOAA has been involved that could potentially affect trust resources, as of August 1995. Table 2 lists acronyms, abbreviations, and terms commonly used in these waste site reports.

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[1]National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300.
[2]Ocean Assessments Division. 1984. *Coastal Hazardous Waste Site Review April 13, 1984.* NOAA/OAD, Seattle, Washington.
[3]Pavia, R., et al. 1985. *Coastal Hazardous Waste Site Review June 1985.* NOAA/OAD, Seattle, Washington

[4]Pavia, R., et al. 1986. *Coastal Hazardous Waste Site Review April 1986.* NOAA/OAD, Seattle, Washington.
[5]Pavia, R., et al. 1987. *Coastal Hazardous Waste Site Review June 1987.* NOAA/OAD, Seattle, Washington.
[6]Pavia, R., et al. 1989. *Coastal Hazardous Waste Site Review March 1989.* NOAA/OAD, Seattle, Washington.
[7]Hoff, R., et al. 1990. *Coastal Hazardous Waste Site Review June 1990.* NOAA/OAD, Seattle, Washington.
[8]Beckvar, N., et al. 1992. *Coastal Hazardous Waste Site Review September 1992.* NOAA/ORCA, Seattle, Washington.
[9]Beckvar, N., et al. 1993. *Coastal Hazardous Waste Site Review December 1993.* NOAA/ORCA, Seattle, Washington.
[10]Beckvar, N., et al. 1995. *Coastal Hazardous Waste Site Review June 1995.* NOAA/ORCA, Seattle, Washington.
[11]U.S. Environmental Protection Agency. 1993. *Water quality criteria.* Washington, D.C.: U.S. Environmental Protection Agency, Office of Water, Health and Ecological Criteria Division. 294 pp.
[12]Lindsay, W.L. 1979. *Chemical Equilibria in Soils.* New York: John Wiley & Sons.
[13]Long, E.R. and D.D. MacDonald. 1992. National Status and Trends Program approach. In: *Sediment Classification Methods Compendium.* EPA 823-R-92-006. Washington, D.C.: EPA Office of Water (WH-556).

Table 1. Sites which NOAA has reviewed (579) as of July 1995, including those sites for which a Coastal Hazardous Waste Site Review (276) or Preliminary Natural Resource Survey (PNRS; 123) has been completed. (Asterisked sites are included in this volume of reports.)

			Report Date	
State	**Cerclis**	**Site Name**	**Review**	**PNRS**
Federal Region 1				
CT	CTD980732333	Barkhamsted-New Hartford Landfill	1989	
CT	CTD072122062	Beacon Heights, Inc.	1984	
CT	CTD108960972	Gallup's Quarry	1989	
CT	CTD980670814	Kellogg-Deering Well Field	1987	
CT	CTD980521165	Laurel Park, Inc.		1988
CT	CTD001153923	Linemaster Switch		
CT	CTD980906515	New London Submarine Base	1990	
CT	CTD980669261	Nutmeg Valley Road		
CT	CTD980667992	O'Sullivans Island	1984	
CT	CTD980670806	Old Southington Landfill		
CT	CTD004532610	Revere Textile Prints Corps		
CT	CTD001449784	Sikorsky Aircraft Div UTC		
CT	CTD009717604	Solvents Recovery Service		
CT	CTD009774969	Yaworski Waste Lagoon	1985	1989
MA	MAD001026319	Atlas Tack Corp	1989	
MA	MAD001041987	Baird & McGuire, Inc.		
MA	MAD982191363	Blackburn & Union Privileges	1993	
MA	MAD079510780	Cannon Engineering Corp., Bridgewater		1988
MA	MAD980525232	Cannon Engineering Corp., Plymouth	1984	1990
MA	MAD003809266	Charles George Land Reclamation	1987	1988
MA	MAD980520670	Fort Devens - Sudbury Training Annex		
MA	MA7210025154	Fort Devens		
MA	MAD980732317	Groveland Wells 1&2	1987	1988
MA	MA8570024424	Hanscom Air Force Base	1995	
MA	MAD980523336	Haverhill Municipal Landfill	1985	
MA	MAD980732341	Hocomoco Pond		
MA	MAD076580950	Industri-plex	1987	1988
MA	MAD051787323	Iron Horse Park		
MA	MA1210020631	Natick Lab, Army Research, Development, & Eng. Ctr		1995
MA	MA6170023570	Naval Weapons Industrial Reserve Plant	1995*	
MA	MAD980731335	New Bedford	1984	
MA	MAD980670566	Norwood PCB's		
MA	MAD990685422	Nyanza Chemical Waste Dump	1987	1993
MA	MA2570024487	Otis Air National Guard/Camp Edwards		
MA	MAD980731483	PSC Resources		
MA	MAD980520621	Re-Solve, Inc.		
MA	MAD980524169	Rose Disposal Pit		
MA	MAD980525240	Salem Acres		1991
MA	MAD980503973	Shpack Dump		
MA	MAD000192393	Silresim Chemical Corp.		
MA	MA2170022022	South Weymouth Naval Air Station	1995*	
MA	MAD980731343	Sullivan's Ledge	1987	1989
MA	MA0213820939	U.S. Army Materials Technology Laboratory	1995*	
MA	MAD001002252	W. R. Grace and Co. (Acton Plant)		
MA	MAD980732168	Wells G & H		1990
ME	ME8170022018	Brunswick Naval Air Station	1987	1991

State	Cerclis	Site Name	Report Date Review	PNRS
Federal Region 1, cont.				
ME	ME9570024522	Loring Air Force Base		
ME	MED980524078	McKin Company	1984	
ME	MED980731475	O'Connor Company	1984	
ME	ME7170022019	Portsmouth Naval Shipyard	1995*	
ME	MED980732291	Pinettes Salvage Yard		
ME	MED980504393	Saco Municipal Landfill	1989	
ME	MED980520241	Saco Tannery Waste Pits		
ME	MED042143883	Union Chemical Company, Inc.		
ME	ME7170022019	Portsmouth Naval Shipyard		
ME	MED980504435	Winthrop Town Landfill		
NH	NHD980524086	Auburn Road Landfill		1989
NH	NHD064424153	Coakley Landfill	1985	1989
NH	NHD980520191	Dover Municipal Landfill	1987	1990
NH	NHD001079649	Fletcher's Paint Works and Storage	1989	
NH	NHD069911030	Grugnale Waste Disposal Site	1985	
NH	NHD981063860	Holton Circle Ground Water Contamination		
NH	NHD062002001	Kearsarge Metallurgical		
NH	NHD092059112	Keefe Environmental Services		
NH	NHD980503361	Mottolo Pig Farm		
NH	NHD001091453	New Hampshire Plating Co.	1992	
NH	NHD990717647	Ottati & Goss Great Lakes Container Corp		
NH	NH7570024847	Pease Air Force Base	1990	
NH	NHD980671002	Savage Municipal Water Supply	1985	1991
NH	NHD980520225	Somersworth Sanitary Landfill		
NH	NHD980671069	South Municipal Water Supply Well		
NH	NHD099363541	Sylvester	1985	
NH	NHD989090469	Tibbetts Road		
NH	NHD062004569	Tinkham Garage		
RI	RID980520183	Central Landfill (Johnston Site)		
RI	RID980731459	Davis GSR Landfill		
RI	RID980523070	Davis Liquid Waste Site	1987	
RI	RI6170022036	Davisville Naval Construction Battalion Ctr	1990	1994
RI	RID093212439	Landfill and Resource Recovery (L&RR)		
RI	RI6170085470	Newport Naval Education/Training Center	1990	1994
RI	RID055176283	Peterson/Puritan, Inc.	1987	1990
RI	RID980579056	Picillo Farm	1987	1988
RI	RID980521025	Rose Hill Regional Landfill	1989	1994
RI	RID980731442	Stamina Mills	1987	1990
RI	RID009764929	Western Sand and Gravel	1987	
RI	RID981063993	West Kingston Town Dump/URI Disposal Area	1992	
VT	VTD981064223	Bennington Municipal Landfill		
VT	VTD980520092	BFI Sanitary Landfill	1989	
VT	VTD003965415	Burgess Brothers Landfill		
VT	VTD980520118	Darling Hill Dump		
VT	VTD000860239	Old Springfield Landfill	1987	1988
VT	VTD981062441	Parker Sanitary Landfill		
VT	VTD980523062	Pine Street Canal		
VT	VTD000509174	Tansitor Electronics, Inc		

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 2				
NJ	NJD000525154	Albert Steel Drum	1984	
NJ	NJD002173276	American Cyanamid	1985	
NJ	NJD030253355	AO Polymer		
NJ	NJD980654149	Asbestos Dump		
NJ	NJD063157150	Bog Creek Farm	1984	1992
NJ	NJD980505176	Brick Township Landfill	1984	
NJ	NJD053292652	Bridgeport Rental & Oil Services (BROS)		1990
NJ	NJD078251675	Brook Industrial Park	1989	
NJ	NJD980504997	Burnt Fly Bog		1992
NJ	NJD048798953	Caldwell Trucking Co.		
NJ	NJD000607481	Chemical Control	1984	
NJ	NJD980484653	Chemical Insecticide Corp	1990	1992
NJ	NJD047321443	Chemical Leaman		1989
NJ	NJD980528889	Chemsol, Inc.		
NJ	NJD980528897	Chipman Chemical	1985	
NJ	NJD001502517	Ciba-Geigy Corp.	1984	1989
NJ	NJD980785638	Cinnaminson		
NJ	NJD094966611	Combe Fill South Landfill		
NJ	NJD000565531	Cosden Chemical	1987	
NJ	NJD002141190	CPS Chemical/Madison Industries		1990
NJ	NJD011717584	Curcio Scrap Metal	1987	
NJ	NJD980529002	Delilah Landfill		
NJ	NJD046644407	Denzer and Schafer X-Ray	1984	1992
NJ	NJD980761373	De Rewal Chemical Co.	1985	
NJ	NJD980528996	Diamond Alkali/Diamond Shamrock	1984	
NJ	NJD980529416	D'Imperio Property		
NJ	NJD980529085	Ellis Property		
NJ	NJD980654222	Evor Phillips Leasing		1992
NJ	NJD980761365	Ewan		
NJ	NJ9690510020	FAA Tech Center	1990	
NJ	NJ2210020275	Fort Dix (Landfill)		
NJ	NJD041828906	Fried Industries		
NJ	NJD053280160	Garden State Cleaners	1989	
NJ	NJD980529192	Gems Landfill		
NJ	NJD063160667	Global Sanitary Landfill	1989	1991
NJ	NJD980530109	Goose Farm		
NJ	NJD980505366	Helen Kramer Landfill		1990
NJ	NJD002349058	Hercules, Inc.	1984	1993
NJ	NJD053102232	Higgins Disposal Service Inc.	1989	
NJ	NJD981490261	Higgins Farm	1989	
NJ	NJD980663678	Horseshoe Road Industrial Complex[1]	1984/1995	
NJ	NJD980532907	Ideal Cooperage	1984	
NJ	NJD980654099	Imperial Oil Co. Inc./Champion Chemicals		
NJ	NJD981178411	Industrial Latex	1989	
NJ	NJD980505283	Jackson Township Landfill	1984	
NJ	NJ0141790006	Jamaica Bay (Gateway Recreational Area)		
NJ	NJD097400998	JIS Landfill		
NJ	NJD002493054	Kauffman and Minteer	1989	

[1]Previously known as Horseshoe Road Dump

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 2, cont.				
NJ	NJD049860836	Kin-Buc Landfill	1984	1990
NJ	NJD980505341	King of Prussia		
NJ	NJD002445112	Koppers Company/Seaboard Plant	1984	
NJ	NJD980529838	Krysowaty Farm	1985	
NJ	NJD980505416	Lipari Landfill		
NJ	NJD980505424	Lone Pine Landfill		1992
NJ	NJD085632164	M&T Delisa Landfill		
NJ	NJD980654180	Mannheim Avenue Dump		
NJ	NJD980529762	Maywood Chemical Co.		
NJ	NJD002517472	Metaltec/Aerosystems		
NJ	NJ0210022752	Military Ocean Terminal (Landfill)		
NJ	NJD000606756	Mobil Chemical Company	1984	
NJ	NJD980505671	Monroe Township Landfill		
NJ	NJD980654198	Myers Property		
NJ	NJD061843249	N.L. Industries	1984	1992
NJ	NJD002362705	Nascolite Corp.		
NJ	NJ7170023744	Naval Air Engineering Center, Lakehurst		
NJ	NJ0170022172	Naval Weapons Station, Earle - Site A		
NJ	NJD980529598	Pepe Field		
NJ	NJD980653901	Perth Amboy's PCB's	1984	
NJ	NJD980505648	PJP Landfill	1984	1990
NJ	NJD981179047	Pohatcong Valley Groundwater Cont.		
NJ	NJD980769350	Pomona Oaks		
NJ	NJD070281175	Price Landfill	1984	1993
NJ	NJD980582142	Pulverizing Services Inc.		
NJ	NJD000606442	Quanta Resources (Allied, Shady Side)		
NJ	NJD980529713	Reich Farms		
NJ	NJD070415005	Renora, Inc.		
NJ	NJD980529739	Ringwood Site		
NJ	NJD073732257	Roebling Steel Company	1984	1990
NJ	NJD030250484	Roosevelt Drive-In	1984	
NJ	NJD986623569	Sayreville Pesticide Dump[2]	1984	
NJ	NJD980505754	Sayreville Landfill	1984	1990
NJ	NJD070565403	Scientific Chemical Processing, Inc.	1984	1989
NJ	NJD980505762	Sharkey Landfill		1990
NJ	NJD002365930	Shield Allow Corporation		
NJ	NJD980766828	South Jersey Clothing Co.	1989	
NJ	NJD041743220	Swope Oil & Chemical Co.		
NJ	NJD064263817	Syncon Resins	1984	1992
NJ	NJD980529127	T. Fiore Demolition, Inc.	1984	
NJ	NJD980761357	Tabernacle Drum Dump		
NJ	NJD002005106	Universal Oil Products, Inc.	1984	
NJ	NJD980761399	Upper Deerfield Township Sanitary Landfill		
NJ	NJD980529879	Ventron/Velsicol	1984	
NJ	NJD002385664	Vineland Chemical		1990
NJ	NJD054981337	Waldick Aerospace Devices		1990
NJ	NJD001239185	White Chemical Company	1984	
NJ	NJD980529945	Williams Property	1984	1992

[2]Now part of Horseshoe Road Industrial Complex

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 2, cont.				
NJ	NJD980532824	Wilson Farm		
NJ	NJD045653854	Witco Chemical Corporation		
NJ	NJD980505887	Woodland Route 532 Dump		
NJ	NJD980505879	Woodland Route 72 Dump		
NY	NYD072366453	Action Anodizing Site	1989	
NY	NYD980506232	ALCOA Oil and Wastewater Lagoons		
NY	NYD002066330	American Thermostat		
NY	NYD001485226	Anchor Chemical		
NY	NYD980535652	Applied Environmental Services	1985	1991
NY	NYD980507693	Batavia Landfill		
NY	NYD980768675	BEC (Binghampton Equipment Co.) Trucking		1990
NY	NYD980768683	Bioclinical Laboratories		
NY	NYD980652275	Brewster Wellfield		
NY	NY7890008975	Brookhaven National Lab	1990	
NY	NYD980780670	Byron Barrel and Drum		
NY	NYD981561954	C and J Disposal Site	1989	
NY	NYD010968014	Carrol and Dubies Sewage Disposal	1989	
NY	NYD981184229	Circuitron Corp. Site		
NY	NYD002044584	Claremont Polychemical		
NY	NYD000511576	Clothier Disposal		
NY	NYD980768691	Colesville Municipal Landfill		
NY	NYD980528475	Cortese Landfill		
NY	NYD980508048	Croton Point Sanitary Landfill		
NY	NYD980780746	Endicott Village Wellfield		
NY	NYD981560923	Forest Glen Subdivision		
NY	NYD002050110	Genzale Plating Site		
NY	NYD091972554	GM Foundry		1989
NY	NYD980768717	Goldisc Recordings, Inc.		
NY	NY4571924451	Griffiss AFB		
NY	NYD980785661	Haviland Complex		
NY	NYD980780779	Hertel Landfill		
NY	NYD002920312	Hooker/Ruco Polymer Corp.		
NY	NYD980763841	Hudson River PCBs (GE)		1989
NY	NYD000813428	Jones Chemicals, Inc.		
NY	NYD980534556	Jones Sanitation	1987	
NY	NYD980780795	Katonah Municipal Well		
NY	NYD986882660	Li Tungsten	1992	1993
NY	NYD053169694	Liberty Heat Treating Co., Inc.		
NY	NYD000337295	Liberty Industrial Finishing	1985	1993
NY	NYD013468939	Ludlow Sand & Gravel		
NY	NYD010959757	Marathon Battery	1984	1989
NY	NYD000512459	Mattiace Petrochemical	1989	1990
NY	NYD980763742	MEK Spill, Hicksville		
NY	NYD002014595	Nepera Chem Co., Inc.		
NY	NYD980506810	Niagara 102nd Street (Hooker Chem)		
NY	NYD000514257	Niagara County Refuse		
NY	NYD980664361	Niagara Mohawk Power Corp.		
NY	NYD980780829	Ninety-Third Street School		
NY	NYD980762520	North Sea Municipal Landfill	1985	1989
NY	NYD991292004	Pasley Solvents		
NY	NY6141790018	Pennsylvania Ave. Landfill		

State	Cerclis	Site Name	Report Date Review	PNRS
Federal Region 2, cont.				
NY	NYD000511659	Pollution Abatement Services		
NY	NYD980654206	Port Washington Landfill	1984	1989
NY	NYD980768774	Preferred Plating Corp.		
NY	NYD002245967	Reynolds Metal Co.		
NY	NYD980507735	Richardson Hill Road Landfill		
NY	NYD980535124	Rocket Fuel Site - MALTA		
NY	NYD981486954	Rowe Industries	1987	1991
NY	NYD980507677	Sidney Landfill	1989	
NY	NYD980535215	Sinclair Refinery Site		
NY	NYD980421176	Solvent Savers		
NY	NYD980780878	Suffern Wellfield Site		
NY	NYD000511360	Syosset Landfill		
NY	NYD002059517	Tronic Plating		
NY	NYD980509376	Volney Landfill		
NY	NYD980535496	Wallkill Landfill		
NY	NYD980506679	Warwick Landfill Site		
NY	NYD000511733	York Oil		
PR	PRD090416132	Clear Ambient Service	1984	
PR	PRD980640965	Frontera Creek	1984	1991
PR	PRD090282757	GE Wiring Devices		
PR	PRD980512362	Juncos Landfill		
PR	PR4170027383	Naval Security Group Activity, Sabana Seca	1989	1991
PR	PRD980301154	Upjohn		
PR	PRD980763775	Vega Alta Public Supply Wells		
USVI	VID982272569	Tutu Wellfield	1993	
Federal Region 3				
DE	DED980494496	Army Creek Landfill	1984	
DE	DED980714141	Chem-Solv, Inc.		
DE	DED980704860	Coker's Sanitation Services Landfills	1986	1990
DE	DED980551667	Delaware City PVC	1984	
DE	DED000605972	Delaware Sand & Gravel Landfill	1984	
DE	DE8570024010	Dover Air Force Base	1987	1989
DE	DED980693550	Dover Gas and Light Company	1987	
DE	DED980555122	E.I. Du Pont - Newport Landfill	1987	1991/1992[3]
DE	DED980830954	Halby Chemical Company	1986	1990
DE	DED980713093	Harvey & Knott Drum		
DE	DED980705727	Kent Co. Landfill	1989	
DE	DED980552244	Koppers Company Facilities site	1990	
DE	DED043958388	National Cash Register Corp., Millsboro	1986	
DE	DED058980442	New Castle Spill Site	1984	1989
DE	DED980705255	New Castle Steel	1984	
DE	DED980704894	Old Brine Sludge Landfill	1984	
DE	DED980494603	Pigeon Point Landfill	1987	
DE	DED981035520	Sealand	1989	
DE	DED041212473	Standard Chlorine of Delaware, Inc.	1986	
DE	DED980494637	Sussex Co. Landfill #5	1989	
DE	DED000606079	Tybouts Corner Landfill	1984	

[3] PNRS updated in 1992.

State	Cerclis	Site Name	Report Date Review	PNRS
Federal Region 3, cont.				
DE	DED980705545	Tyler Refrigeration Pit Site		
DE	DED980704951	Wildcat Landfill	1984	
MD	MDD980504187	Aberdeen Dump	1986	
MD	MDD980705057	Anne Arundel County Landfill	1989	
MD	MD0120508940	Beltsville Agricultural Research Center	1995	
MD	MDD980504195	Bush Valley Landfill	1989	
MD	MDD982364341	Ordnance Products, Inc.	1995	
MD	MDD980705164	Sand Gravel & Stone Site	1984	1990
MD	MDD064882889	Mid-Atlantic Wood Preservers		
MD	MDD980704852	Southern Maryland Wood Treating	1987	
MD	MD2210020036	USA Aberdeen - Edgewood	1986	
MD	MD3210021355	USA Aberdeen - Michaelsville	1986	
MD	MDD980504344	Woodlawn Co Landfill	1987	
PA	PAD004351003	A.I.W. Frank/Mid-County Mustang		
PA	PAD000436436	Ambler Asbestos Piles		
PA	PAD009224981	American Electronic Lab, Inc.		
PA	PAD980693048	AMP, Inc.		
PA	PAD987341716	Austin Avenue Radiation Site	1993	
PA	PAD061105128	Bally Township		
PA	PAD047726161	Boarhead Farms	1989	
PA	PAD980831812	Brown's Battery		1991
PA	PAD980508451	Butler Mine Tunnel	1987	
PA	PAD980419097	Crater Resources, Inc.	1993	
PA	PAD981035009	Croydon TCE Spill	1986	
PA	PAD981038052	Delta Quarries/Stotler Landfill		
PA	PAD002384865	Douglassville Disposal Site	1987	
PA	PAD003058047	Drake Chemical		
PA	PAD980830533	Eastern Diversified Metals		
PA	PAD980552913	Enterprise Avenue	1984	
PA	AD077087989	Foote Mineral Company	1993	
PA	PAD002338010	Havertown PCP		
PA	PAD002390748	Hellertown Manufacturing Company	1987	
PA	PAD009862939	Henderson Road		1989
PA	PAD980829493	Jacks Creek/Sitkin Smelting & Refining	1989	
PA	PAD981036049	Keyser Ave. Borehole	1989	
PA	PAD980508667	Lackawanna Refuse		
PA	PA2210090054	Letterkenny-Property Disposal Area (USA)		
PA	PA6213820503	Letterkenny-Southeast Industrial Area (USA)		
PA	PAD046557096	Metal Bank of America	1984	1990
PA	PAD980538763	Middletown Air Field		
PA	PAD980539068	Modern Sanitation Landfill		
PA	PAD980691372	MW Manufacturing		
PA	PAD096834494	North Penn-Area 1		
PA	PAD980229298	Occidental Chemical/Firestone	1989	
PA	PAD002395887	Palmerton Zinc Pile		
PA	PAD980692594	Paoli Railyard	1987	1991
PA	PAD981939200	Publicker Industries/Cuyahoga Wrecking Plant	1990	
PA	PAD039017694	Raymark		
PA	PAD002353969	Recticon/Allied Steel	1989	
PA	PAD051395499	Revere Chemical Company	1986	
PA	PAD091637975	Rohm and Haas Landfill	1986	

State	Cerclis	Site Name	Report Date Review	PNRS
Federal Region 3, cont.				
PA	PAD002498632	Spra-Fin, Inc. (North Penn-Area 7)		
PA	PAD014269971	Stanley Kessler		
PA	PA6143515447	Tinicum National Environmental Center	1986	
PA	PAD980692024	Tysons Dump #1	1985	
PA	PAD980539126	UGI Columbia Gas Plant	1995*	
PA	PA6170024545	U.S. Navy Naval Air Warfare Center		
PA	PAD980539407	Wade (ABM) Site	1984	
PA	PAD980537773	William Dick Lagoons		
VA	VAD980551683	Abex Corp.	1989	
VA	VAD042916361	Arrowhead Assoc/Scovill Corp	1989	
VA	VAD990710410	Atlantic Wood Industries	1987	1990
VA	VAD049957913	C&R Battery Co., Inc.	1987	
VA	VAD980712913	Chisman Creek	1984	
VA	VAD007972482	Clarke, L.A. & Son		
VA	VAD980539878	H & H Inc.		
VA	VA1170024722	Marine Corps Combat Development Command	1995	
VA	VA2800005033	NASA-Langley Research Center	1995	
VA	VA7170024684	Naval Surface Weapons Center, Dahlgren	1993	
VA	VA8170024170	Naval Weapons Station Yorktown	1993	
VA	VAD071040752	Rentokil Inc. Wood Preserving		
VA	VAD980831796	Rhinehart Tire Fire Dump		
VA	VAD003117389	Saunders Supply Co.	1987	
VA	VAD980917983	Suffolk City Landfill Waste Disposal Ponds		
VA	VA3971520751	U.S. Defense General Supply Center		
Federal Region 4				
AL	ALD001221902	Ciba-Geigy Corp	1990	
AL	ALD008188708	Olin Corp. McIntosh Plant	1990	
AL	ALD980844385	Redwing Carriers Inc./Saraland	1989	
AL	ALD095688875	Stauffer Chemical Co. Cold Creek Plt./Lemoyne		1990
AL	ALD007454085	T.H. Agriculture Nutrition Co.		
FL	FLD980728877	62nd Street Dump/Kassouf-Kimerling	1984	1989
FL	FLD980221857	Agrico Chemical Site	1989	
FL	FLD008161994	American Creosote Works	1984	1989
FL	FLD088783865	Bay Drum/Tampa		
FL	FLD980494660	Beulah Landfill		
FL	FLD981930506	Broward County - 21st Manor Dump	1992	
FL	FL5170022474	Cecil Field Naval Air Station	1990	
FL	FLD080174402	Chem-Form Inc.	1990	
FL	FLD050432251	Florida Steel Corporation		
FL	FLD000827428	Gardinier, Inc./Ft. Meade Mine		
FL	FLD000602334	Harris Corp. (Palm Bay Plant)	1986	1990
FL	FLD053502696	Helena Chemical Company	1993	
FL	FLD980709802	Hipps Road Landfill		
FL	FLD004119681	Hollingsworth Solderless Terminal Co.		
FL	FL7570024037	Homestead Air Force Base		
FL	FL6170024412	Jacksonville Naval Air Station	1990	
FL	FLD084535442	Munisport Landfill	1984	
FL	FL6170022952	Naval Air Station Key West (Boca Chica)		
FL	FLD004091807	Peak Oil Co.		
FL	FL9170024567	Pensacola Naval Air Station	1990	

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 4, cont.				
FL	FLD980556351	Pickettville Road Landfill	1984	1990
FL	FLD004054284	Piper Aircraft Corp., Vero Beach		
FL	FLD000824888	Reeves SE Corp., Wire Div.		
FL	FLD980602882	Sapp Battery Salvage		1989
FL	FLD062794003	Schuylkill Metal Corp		
FL	FLD004126520	Standard Auto Bumper Corp.	1989	
FL	FLD010596013	Stauffer Chemical Co., Tarpon Springs	1993	
FL	FLD004092532	Stauffer Chemical Co., Tampa	1993	
FL	FLD000648055	Sydney Mine Sludge Ponds		1989
FL	FL1690331300	USCG Station Key West		
FL	FLD980602767	Whitehouse Waste Oil Pits		
FL	FLD041184383	Wilson Concepts of Florida		
FL	FLD981021470	Wingate Road Municipal Incinerator Dump		
FL	FLD004146346	Woodbury Chemical Co.	1989	
GA	GAD095840674	Cedartown Industries Inc.		
GA	GAD990741092	Diamond Shamrock Corp. Landfill		
GA	GAD990855074	Firestone Tire & Rubber Co. Inc.		
GA	GAD004065520	Hercules Inc.		
GA	GAD980556906	Hercules 009 Landfill		
GA	GAD000827444	International Paper Co.		
GA	GAD099303182	LCP Chemicals - Georgia, Inc.		1995
GA	GA7170023694	Marine Corps Logistics Base 555		
GA	GAD001700699	Monsanto Co.		
GA	GAD042101261	T.H. Agriculture & Nutrition Co.., Albany		
GA	GA1570024330	USAF Robins Air Force Base		
GA	GAD003269578	Woolfolk Chemical Works, Inc.		
MS	MSD008154486	Chemfax, Inc.	1995*	
MS	MSD098596489	Gautier Oil Co. Inc.	1989	
NC	NCD024644494	ABC One Hour Cleaners	1989	
NC	NCD980840409	Charles Macon Lagoon & Drum Storage		
NC	NCD980840342	Dockery Property		
NC	NCD981475932	FCX (Washington Plant)	1989	
NC	NCD981021157	New Hanover County Airport Burn Pit	1989	
NC	NCD981023260	Potter's Septic Tank Service Pits	1989	
NC	NC1170027261	USMC Air Station Cherry Point		
NC	NC6170022580	USMC Camp Lejuene, Site 21	1989	
SC	SCD980844260	Beaufort County Landfill		
SC	SCD987581337	Calhoun Park/Ansonborough Homes/SCEGCO		1993
SC	SCD980711279	Geiger (C&M Oil)	1984	
SC	SCD058753971	Helena Chemical Co.	1989	
SC	SCD055915086	International Paper/Sampit River		
SC	SCD980310239	Koppers Company, Inc., Charleston Plant	1993	
SC	SC8170022620	Naval Weapons Station - Charleston		
SC	SC1890008989	Savannah River Site (USDOE)	1990	
SC	SCD037405362	Wamchem Inc.	1984	
Federal Region 6				
TX	TXD008123168	ALCOA (Point Comfort)/Lavaca Bay)	1995*	
LA	LAD000239814	American Creosote, Inc., Winnfield		
LA	LAD980745632	Bayou Bonfouca		
LA	LAD980745541	Bayou Sorrell	1984	

State	Cerclis	Site Name	Report Date Review	PNRS
Federal Region 6, cont.				
LA	LAD980501423	Calcasieu Parish Landfill		
LA	LA6170022788	New Orleans Naval Air Station		
LA	LAD057482713	Petro-Processors of Louisiana, Inc.		
TX	TXD008123168	ALCOA/Point Comfort	1995	
TX	TXD980864649	Bailey Waste Disposal	1985	1989
TX	TXD980625453	Brio Refining , Inc.	1989	1989
TX	TXD990707010	Crystal Chemical Company	1989	1989
TX	TXD089793046	Dixie Oil Processors	1989	1989
TX	TXD980514814	French Limited	1989	1989
TX	TXD980748453	Geneva Industries/Fuhrmann Energy Corp		
TX	TXD980745582	Harris (Farley Street)		
TX	TXD980514996	Highlands Acid Pit	1989	
TX	TXD980625636	Keown Supply Co.		
TX	TXD980629851	Motco Corp.	1984	
TX	TXD980873343	North Cavalcade Street		
TX	TXD980873350	Petro-Chemical Systems, Inc.		
TX	TXD980513956	Sikes Disposal Pits	1989	
TX	TXD980873327	Sol Lynn/Industrial Transformers		
TX	TXD980810386	South Cavalcade Street		
TX	TXD062113329	Tex-Tin Corporation	1989	
TX	TXD055143705	Triangle Chemical Company		
Federal Region 9				
AS	ASD980637656	Taputimu Farm, Tutuila Isl.	1984	
CA	CA2170023236	Alameda Naval Air Station	1989	
CA	CAD052384021	Brown & Bryant, Inc. (Arvin Plant)		
CA	CA2170023533	Camp Pendleton Marine Corps Base	1990	1992
CA	CAD009114919	Chevron USA Richmond Refinery		
CA	CAD063015887	Coast Wood Preserving	1984	
CA	CAD055753370	Cooper Drum Company	1993	
CA	CAD980498455	Crazy Horse Sanitary Landfill		
CA	CAD009212838	CTS Printex, Inc.	1989	
CA	CAD029544731	Del Amo	1992	
CA	CAD000626176	Del Norte County Pesticide Storage Area	1984	
CA	CA6170023208	El Toro Marine Corps Air Station	1989	
CA	CAD981159585	Farallon Islands Radioactive Waste Dumps		1990
CA	CA7210020676	Fort Ord	1990	1992
CA	CAD980636914	Fresno Municipal Sanitary Landfill		
CA	CAD980498562	GBF and Pittsburg Dumps	1989/1993[4]	
CA	CA3570024288	Hamilton Air Force Base		
CA	CAD980884209	Hewlett-Packard (620-40 Page Mill Rd)	1989	
CA	CAD058783952	Hexcel Corp. - Livermore		
CA	CA1170090087	Hunters Point Annex/Treasure Island Naval Air Station	1989	1989
CA	CAD041472341	Intersil Inc./Siemens Components	1989	
CA	CAD980498612	Iron Mountain Mine	1989	1989
CA	CAD000625731	J.H. Baxter		
CA	CAD009103318	Jasco Chemical Corp.	1989	

[4]Waste Site Review updated in 1993.

State	Cerclis	Site Name	Report Date Review	PNRS
Federal Region 9, cont.				
CA	CAD008274938	Kaiser Steel Corp. (Fontana Plant)		
CA	CAD981429715	Kearney - KPF		
CA	CAT000646208	Liquid Gold Oil Corp.	1984	
CA	CAD065021594	Louisiana Pacific Corp.		
CA	CA7170024775	Mare Island Naval Shipyard		
CA	CAD000074120	MGM Brakes	1984	
CA	CAD009106527	McCormick & Baxter Creosoting Company	1993	
CA	CAD982463812	Middlefield-Ellis-Whisman		
CA	CAD981997752	Modesto Ground Water Contamination		
CA	CA2170090078	Moffett Field Naval Air Station	1986	
CA	CAD008242711	Montrose Chemical Corp.	1985	
CA	CA7170024528	Naval Weapons Station, Concord	1989/1993[4]	1990
CA	CAD981434517	Newmark Ground Water Contamination		
CA	CA7170090016	North Island Naval Air Station		
CA	CA4170090027	Oakland Naval Supply Center		
CA	CAD980636781	Pacific Coast Pipelines	1989	
CA	CA9170027271	Pacific Missile Test Center		
CA	CA1170090236	Point Loma Naval Complex		
CA	CAD982462343	Redwood Shore Landfill		
CA	CAT000611350	Rhone-Poulenc, Inc./Zoecon Corp.	1985	
CA	CA7210020759	Riverbank Army Ammunition Plant	1989	
CA	CAD009452657	Romic Chemical Corp		
CA	CA0210020780	Sacramento Army Depot		
CA	CAD009164021	Shell Oil Co., Martinez Manufact. Complex		
CA	CAD980637482	Simpson - Shasta Ranch		
CA	CAD981171523	Sola Optical USA, Inc.	1989	
CA	CAD059494310	Solvent Service, Inc.		
CA	CAD980894885	South Bay Asbestos Area, Alviso	1985	
CA	CAD009138488	Spectra-Physics, Inc.		
CA	CAD980893275	Sulphur Bank Mercury Mine		
CA	CAD990832735	Synertek, Inc. - Building 1		
CA	CA5570024575	Travis Air Force Base	1990	
CA	CAD009159088	TRW Microwave, Inc. - Building 825		
CA	CAD981436363	United Heckathorn		
CA	CAD981995947	Westminster Tract #2633 (Ralph Gray Trucking Co.)		
GU	GU6571999519	Andersen Air Force Base	1993	
GU	GU7170027323	Naval Station Guam		
HI	HID980637631	Del Monte Corporation (Oahu Plantation)	1995	
HI	HID981581788	Hawaiian Western Steel Limited		
HI	HID980497184	Kailua-Kona Landfill		
HI	HID980497226	Kewalo Incinerator Ash Dump		
HI	HI6170022762	MCAS Kanehoe Landfill		
HI	HID980497176	Kapaa Landfill		
HI	HI3170024340	Naval Submarine Base		
HI	HID980585178	Pearl City Landfill	1984	
HI	HI2170024341	Pearl Harbor Naval Complex	1992	1993
HI	HID982400475	Waiakea Pond/Hawaiian Cane Products		1990
Federal Region 10				
AK	AK4170024323	Adak Naval Air Station	1993	
AK	AKD009252487	Alaska Pulp Corporation		

State	Cerclis	Site Name	Report Date Review	Report Date PNRS
Federal Region 10, cont.				
AK	AK8570028649	Elmendorf Air Force Base	1990	1990
AK	AK6214522157	Fort Richardson	1995*	
AK	AK6210022426	Fort Wainwright		
AK	AKD980978787	Standard Steel & Metals Salvage Yard (USDOT)	1990	1990
ID	IDD980725832	Blackbird Mine	1995	
OR	ORD009051442	Allied Plating	1987	1988
OR	ORD095003687	Gould Inc.	1984	1988
OR	ORD068782820	Joseph Forest Products		
OR	ORD052221025	Martin Marietta Aluminum Co.	1987	1988
OR	ORD009020603	McCormick & Baxter Creosoting Company	1995*	
OR	ORD980988307	Northwest Pipe & Casing Company	1993	
OR	ORD009025347	Stauffer Chemical Co. (Rhone-Poulenc, Inc.)	1984	
OR	ORD009042532	Taylor Lumber and Treating, Inc.		1991
OR	ORD050955848	Teledyne Wah Chang Albany	1985	1988
OR	ORD009049412	Union Pacific, The Dalles	1990	1990
WA	WAD009045279	ALCOA (Vancouver Smelter)	1989	1989
WA	WAD057311094	American Crossarm & Conduit Co.	1989	1988
WA	WA5170027291	Bangor Naval Submarine Base	1990	1991
WA	WA7170027265	Bangor Ordnance Disposal(Site A)		1991
WA	WA1891406349	Bonneville Power Admin. Ross Complex (USDOE)	1990	1990
WA	WAD980836662	Centralia Landfill	1989	1989
WA	WAD980726301	Commencement Bay - South Tacoma Channel	1984[5]	
WA	WAD980726368	Commencement Bay Nearshore/Tideflats	1984[5]	1988
WA	WA5210890096	Hamilton Island Landfill (USACOE)		
WA	WA3890090076	Hanford - 100 Area (DOE)	1989	1988
WA	WA2890090077	Hanford - 300 Area (DOE)		
WA	WAD980722839	Harbor Island - Lead	1984	1989
WA	WA3170090044	Jackson Park Housing Complex (U.S. Navy)	1995*	
WA	WA5170090059	NAS Whidbey Island - Ault Field	1986	1989
WA	WA6170090058	NAS Whidbey Island - Seaplane Base	1986	1989
WA	WA1170023419	Naval Undersea Warfare (4 Areas)		1989
WA	WAD027315621	Northwest Transformer (South Harkness)	1989	1988
WA	WAD009248287	Pacific Sound Resources (Wyckoff Co.,/West Seattle)	1995[6]	1992
WA	WAD009422411	Pacific Wood Treating		
WA	WA4170090001	Port Hadlock Detachment (U.S. Navy)		1995[7]
WA	WA2170023418	Puget Sound Naval Shipyard Complex	1995	
WA	WA2170023426	Puget Sound Naval Supply Center (Old Navy Dump)		1995
WA	WAD980639215	Quendall Terminals	1985	
WA	WAD980639462	Seattle Municipal Landfill (Kent Highlands)	1989	1988
WA	WAD980976328	Strandley/Manning Site		1992
WA	WAD980639256	Tulalip Landfill	1992	1991
WA	WAD009487513	Western Processing	1984	
WA	WAD009248295	Wyckoff Company/Eagle Harbor	1986	1988

[5]A single site report was done for both of these sites.

[6]Previous Waste Site Review done in 1986; previous PNRS done in 1988.

[7]Previous PNRS done in 1989.

Table 2. Acronyms and abbreviations used in Coastal Hazardous Waste Site Reviews

AWQC	Ambient water quality criteria for the protection of aquatic life
bgs	below ground surface
BHC	benzene hexachloride
BNA	base, neutral, and acid-extractable organic compounds
BOD	biological oxygen demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
cm	centimeter
COD	chemical oxygen demand
COE	U.S. Army Corps of Engineers
CRC	Coastal Resource Coordinator
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DNT	dinitrotoluene
DOD	U.S. Department of Defense
DOI	U.S. Department of the Interior
EPA	U.S. Environmental Protection Agency
ERL	Effects range-low
ERM	Effects range-median
ETAG	Ecological and Technical Assessment Group
HMX	cyclotetramethylene tetranitramine
HRS	Hazard Ranking System
IRM	Immediate Removal Measure
kg	kilogram
km	kilometer
l	liter
LOEL	Lowest Observed Effects Level
m	meter
m^3/second	cubic meter per second
µg/g	micrograms per gram
µg/kg	micrograms per kilogram
µg/l	micrograms per liter
µR/hr	microroentgens/hour
mg	milligram
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
mR/hr	milliroentgens per hour
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OU	Operable Unit
PAH	polynuclear aromatic hydrocarbon
PA/SI	Preliminary Assessment/Site Investigation
PCB	polychlorinated biphenyl
PCE	perchloroethylene (aka tetrachloroethylene)
pCi/g	pico Curies per gram (1 pico Curie=10^{-12} Curie)
pCi/l	pico Curies per liter
PCP	pentachlorophenol
PNRS	Preliminary Natural Resource Survey
ppb	parts per billion
ppm	parts per million

Table 2. Acronyms and abbreviations, cont.

ppt	parts per thousand
PRP	Potentially Responsible Party
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RDX	cyclonite
REM/year	Roentgen Equivalent Man per year
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SVOC	semi-volatile organic compound
TCA	1,1,1-trichloroethane
TCE	trichloroethylene
TCL	Target Compound List
TNT	trinitrotoluene
TPH	total petroleum hydrocarbons
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound

1

Naval Weapons Industrial Reserve Plant

Bedford, Massachusetts
CERCLIS #MA6170023570

Site Exposure Potential

The Naval Weapons Industrial Reserve Plant (NWIRP) is in Bedford, Massachusetts approximately 180 m from Elm Brook. About 1.9 km from the site, the brook enters the Shawsheen River, which flows for about 40 km before discharging into the Merrimack River (Figure 1). The Merrimack River enters the Atlantic Ocean about 45 km downstream from the mouth of the Shawsheen River.

The basic mission of the NWIRP, which has been at its present location since 1952, is to develop and test advanced weapons systems. A variety of miscellaneous activities at NWIRP have involved the production, storage, and disposal of hazardous wastes. Potentially contaminated sites at NWIRP, along with the type of waste disposed and activities conducted at those sites, are listed in Table 1. Contaminated groundwater from the NWIRP site is partially responsible for VOCs found in production wells at Hartwell Road Well Field, about 200 to 450 m north-northwest of Elm Brook and east of Hartwell Road (TRC Companies, Inc. 1993).

Surface water runoff and groundwater migration are the potential pathways of contaminant transport from the site to NOAA trust resources and associated habitats. An on-site drainage system

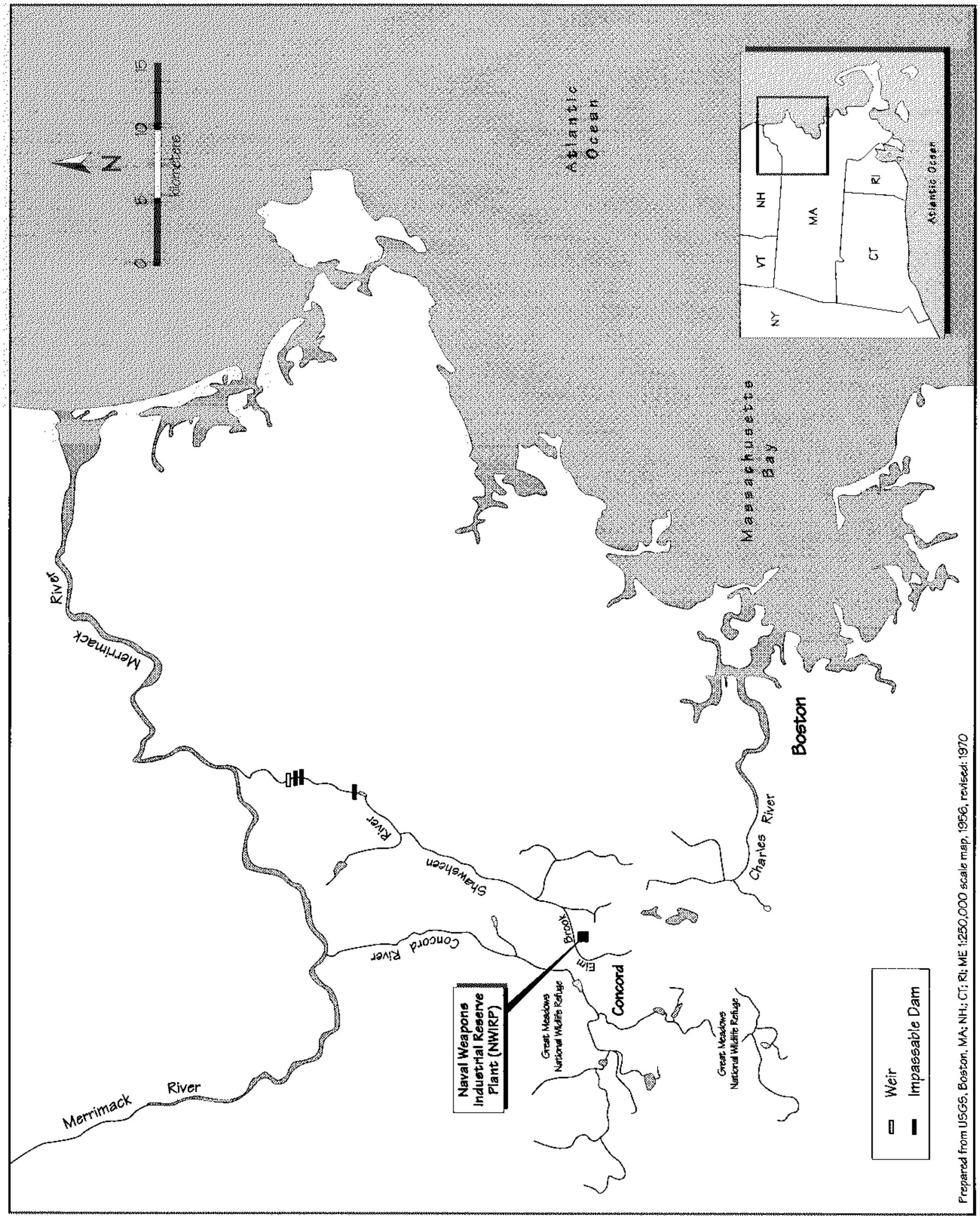

Figure 1. Location of the Naval Weapons Industrial Reserve Plant (NWIRP) in Bedford, Massachusetts.

Table 1. Potential waste sites at the Naval Weapons Industrial Reserve Plant.

Potential Waste Site	Date of Operation	Type of Wastes
Facility Storage Building	Part of the building has been used for vehicle maintenance since 1969, and part has been used as a print shop since 1979.	Various inks, 1,1,1-trichloroethane, and other solvents were used; vehicle maintenance wastes were produced.
Old Barrel Storage Area	Late 1960s to 1981	Drums of waste solvents (including trichloroethylene) and waste oil were stored on exposed, unlined ground.
Old Incinerator Ash Disposal Areas A and B	Unknown	Miscellaneous debris, household trash, ash from incinerated paint and film wastes (likely to contain silver, zinc, lead, and chromium) were disposed.
Components Laboratory and Vicinity	Since 1954	The Components Laboratory houses a number of laboratories and shops that generate hazardous waste, including the Photographic Laboratory, the Metallurgical and Device Testing Laboratory, and Machine Shop. Wastes generated include trichloroethylene and 1,1,1-trichloroethane.
Hawk Van Building	Since 1954	Possible acid wastes from welding
AMRAD	Since 1962	Possible paint wastes, above-ground hydraulic oil storage tanks
Generator Pad Storage Area	Prior to 1981	New solvents were stored on an open-walled pad before 1981. After 1981, chemical wastes and new chemicals, including trichloroethylene, 1,1,1-trichloroethane, and tetrachloroethylene were stored in the Hazardous Waste Storage Shed at the Generator Pad Storage Area.

discharges via several outfalls into extensive wetlands next to the site, which then drain into Elm Brook. Drains from most of the potential waste areas were originally connected to leaching fields. In 1980, flows to the leaching fields were intercepted and connected to the Bedford sewer system (GEI Consultants, Inc. 1991). Surface runoff from the northern portion of the NWIRP facility flows overland into Elm Brook (TRC Companies, Inc. 1993).

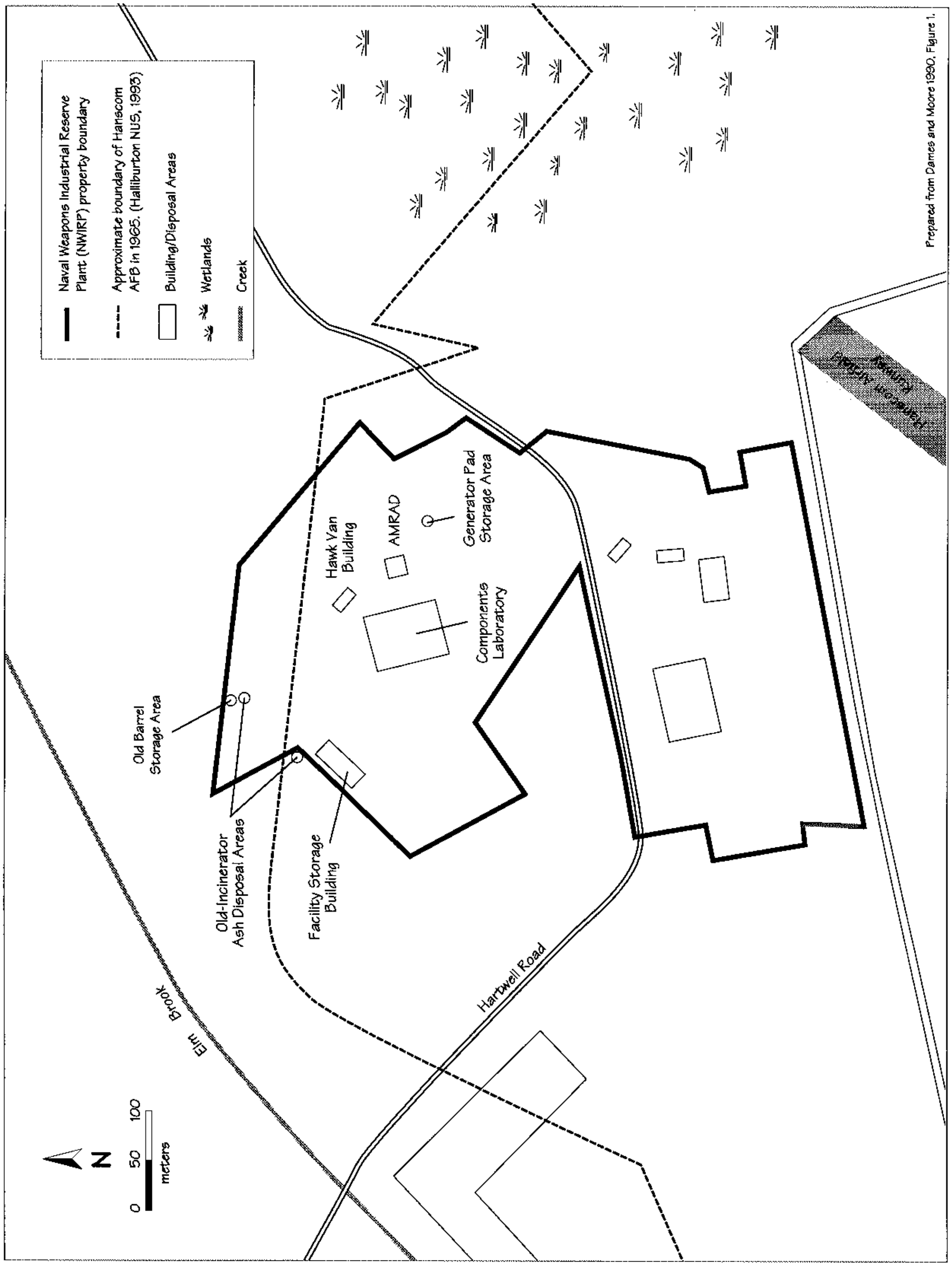

Figure 2. Detail of the Naval Weapons Industrial Reserve Plant (NWIRP).

A surficial, unconfined aquifer occurs 5 to 9 m below the ground surface within lacustrine deposits of glacial origin. A deeper glacial till layer extends below ground surface to bedrock, ranging from 8 to 40 m deep. Groundwater may flow vertically downward or laterally towards surface-water bodies. The site occupies Hartwell's Hill, which rises about 27 m above the surrounding level areas, and groundwater flows radially away from the site. Groundwater from the northwestern part of the site flows north towards Elm Brook, while groundwater from the remainder of the site flows towards the wetland areas to the east (U.S. Department of the Navy 1986).

NOAA Trust Habitats and Species

Habitats of primary concern to NOAA are surface water and associated bottom substrates of Elm Brook and the Shawsheen River. In general, the Shawsheen River is wide, shallow, and slow-moving. Some channelized areas in the river contain gravel and faster-moving water that could be suitable spawning habitat for anadromous fish (Jackson personal communication 1994). The Massachusetts Department of Environmental Quality Engineering has designated Shawsheen River as Class B surface water (fishable and swimmable).

American eel is the only NOAA trust resource near the site. Anadromous fish such as Atlantic salmon, American shad, alewife, and blueback herring may have used the Shawsheen River historically. However, fish passage on the river is restricted by one weir and three dams between the Merrimack River and NWIRP (Jackson personal communication 1994). The first restriction on the Shawsheen River is a weir approximately 6.8 km upstream from the Merrimack River, where fish passage would only be possible at high water. Three dams are situated upstream from the weir at 8.2 km (the J.P. Stevens Dam), 9 km (the Redman Card and Clothing Co. Dam), and 13 km (Ballardvale Dam) upstream from the Merrimack River. Fish passage is not possible at any of these dams. The Shawsheen River is not included in the restoration program for Atlantic salmon in the Merrimack River, so no fish passage facilities are currently proposed. Atlantic salmon, American shad, and alewife have been caught at the confluence of the Shawsheen and Merrimack rivers. It is not known whether those species would travel upstream in the Shawsheen River if there were no barriers to migration.

The Shawsheen River supports a recreational fishery for warmwater fish species. The Massachusetts Division of Fisheries and Wildlife annually stocks trout in both Elm Brook and the Shawsheen River. In 1993, 350 brook trout and 300 brown trout were released in Elm Brook, and 2,000 rainbow trout were released in the Shawsheen River (Jackson personal communication 1994).

There are no health advisories for the consumption of fish caught from Elm Brook or the Shawsheen River.

Site-Related Contamination

A preliminary Remedial Investigation (RI) was conducted in 1989 (Dames and Moore 1990a). During this investigation, a total of 25 soil samples, 23 groundwater samples, and four surface water samples were collected from on-site locations. Groundwater samples were also collected during an additional three rounds of sampling in 1989 and 1990 as a supplement to the RI (Dames and Moore 1990b). Sediment samples were not collected during the RI. Maximum concentrations of contaminants of concern to NOAA detected during the RI sampling are shown in Table 2. The preliminary results indicate that trace elements are present at concentrations sufficient to threaten natural resources. Data were not sufficient to determine whether

Table 2. Maximum concentrations of analytes detected in environmental samples collected from the Naval Weapons Industrial Reserve Plant during initial remedial investigation studies.

	Soil (mg/kg)		Water (µg/l)		
Analyte	Soil	Avg. U.S. Soil[1]	Groundwater[2]	Surface Water	AWQC[3]
TRACE ELEMENTS					
Arsenic	18	5	16	52	190
Chromium	30	100	19	13	11
Copper	27	30	30	212	12+
Lead	27	10	16	33	3.2+
Nickel	29	40	37	ND	160+
Silver	7.7	0.05	8.5	ND	0.12
Zinc	117	50	93	211	110+
ORGANIC COMPOUNDS					
Trichloroethylene (TCE)	ND	NA	2500	ND	21900*
Total PAHs	8.9	NA	NT	NT	NA

1: Lindsay (1979).
2: Filtered groundwater data presented for trace elements.
3: Ambient water quality criteria for the protection of aquatic organisms. Freshwater chronic criteria presented (U.S. EPA 1993).
+: Hardness-dependent criteria (100 mg/l $CaCO_3$ used).
* AWQC was not available; data presented is the Lowest Observed Effects Level (LOEL; U.S. EPA 1993).
NA: Screening guidelines were not available.
ND: Analyte was not detected; detection limits were not available.
NT: Samples were not tested.

there are organic compounds at concentrations of concern.

Only nine soil samples collected near the Old Incinerator Ash Disposal Areas (Figure 2) were analyzed for PAHs. PAHs were detected in these soil samples (Table 2), but screening guidelines were not available for PAHs in soil. Groundwater samples were analyzed for VOCs but not for PAHs. Trichloroethylene (TCE), the primary VOC in groundwater, was consistently detected at elevated concentrations in a monitoring well located near the print shop in the Facility Storage Building. Concentrations of TCE were high compared to background samples, but were substantially lower than the LOEL for the protection of aquatic organisms (U.S. EPA 1993; an AWQC concentration was not available for TCE). Surface water samples were not analyzed for organic compounds. None of the soil, groundwater, or surface water samples was analyzed for PCBs or pesticides.

Data from the initial studies suggest that chromium, copper, lead, silver, and zinc are the primary trace elements of concern at the site. Silver was detected at elevated concentrations of 4.1 and 8.5 µg/l in a groundwater monitoring well near the Old Incinerator Ash Disposal Areas during two out of four sampling rounds. Chromium, copper, lead, and zinc were detected in surface water samples collected from stormwater outfalls at concentrations above their respective screening guidelines.

Summary

Trace elements were detected in surface water discharging from the site at concentrations exceeding screening guidelines. Sediment samples have not been collected, and little information has been collected regarding contamination of groundwater or surface water by PAHs, PCBs, or pesticides. Three dams situated between 27 and 33 km downstream from the site currently block the upstream migration of all NOAA trust species except for American eel. There are no plans to restore anadromous fish populations to the Shawsheen River. Due to the nature of activities, past disposal practices, and proximity to local waterways, it is possible that site-related contaminants have migrated to off-site habitat used by American eel.

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1

Portsmouth Naval Shipyard

Kittery, Maine
CERCLIS #ME7170022019

Site Exposure Potential

Portsmouth Naval Shipyard is located on 112-hectare Seavey Island at the confluence of Portsmouth Harbor and the lower Piscataqua River (Figure 1) in Kittery, Maine. Portsmouth Harbor forms the mouth of the Piscataqua River and is part of the Great Bay Estuary system, which extends about 32 to 40 km into New Hampshire. The site is approximately 4 km inland from the Atlantic Ocean.

The shipyard has been a government facility since 1800 and was built by placing fill among a small group of islands. The primary activities at the shipyard include the repair, overhaul, modernization, and refueling of nuclear submarines. Most of the activities at the shipyard involve heavy industrial operations. There are three operating dry docks on the south and west sides of the island. Over the years, a wide variety of compounds associated with the construction and maintenance of naval vessels have been used and disposed of at the site. Activities that generate hazardous wastes include paint stripping, degreasing and metal surface cleaning operations, cleaning and flushing of hydraulic and cooling systems, and sand blasting. The shipyard has 376 buildings and trade shops, including sheet metal, welding, piping, mechanical, and electrical shops, and a Controlled Industrial Area that includes the dry docks and submarine berths in the western

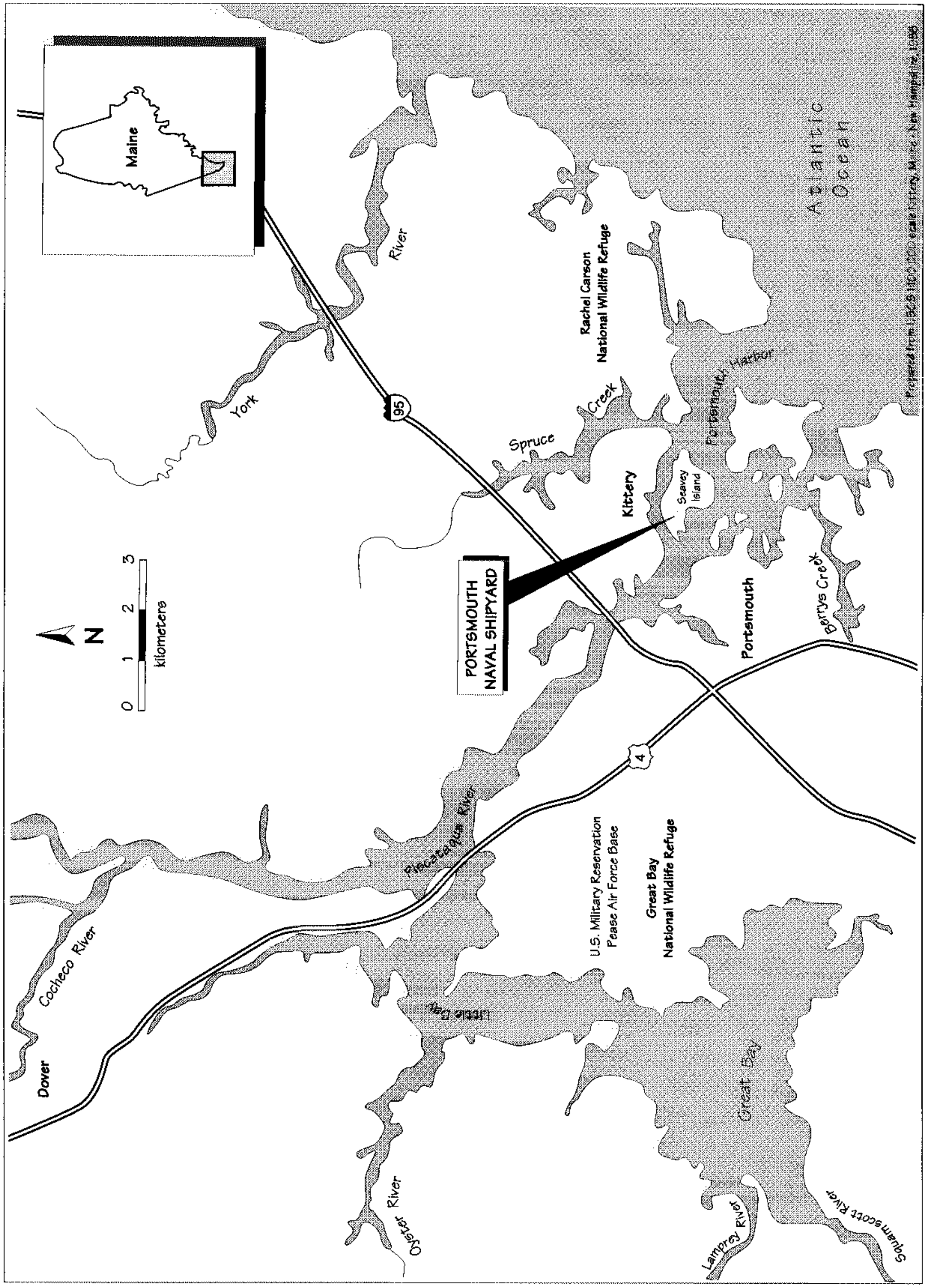

Figure 1. Portsmouth Naval Shipyard in Kittery, Maine.

portion of the island. Industrial wastes are currently collected for pretreatment before disposal at the municipal waste plant in Kittery, Maine.

Thirteen solid waste management units (SWMUs) are being studied for corrective action under RCRA. The SWMUs include former disposal areas, underground storage tanks, industrial waste outfalls (which ceased discharge in 1975), storage areas (still in operation), and a ten-hectare landfill where hazardous wastes were disposed from 1945 to 1975 (NCCOSC and EPA 1993). Table 1 lists each of the thirteen SWMUs that requires corrective action, along with period of operation and types of waste disposed. Figure 2 shows the locations of these SWMUs on the island.

Surface water runoff and groundwater are the potential pathways of contaminant transport from the site to NOAA trust resources and associated habitats. Before 1970, all facility sewage was discharged to the river via sewer outfalls although only stormwater runoff is discharged now. Before the Industrial Waste Treatment Plant was built in 1976, industrial wastes also were discharged directly to the river through outfalls. Surface water runoff flows from Seavey Island into the Piscataqua River as direct runoff or through a stormwater collection system that directs most drainage through various outfalls and ditches around the island. The island is relatively flat with elevations ranging from 3 to 6 m above high water. The shorelines are a combination of steep, rocky banks and low-lying marshlands.

Groundwater on Seavey Island occurs at shallow depths in unconfined, glacial outwash sands and gravels. The permeability of the saturated zone on Seavey Island is not known, although it may be highly variable due to the variety of subsurface materials present. Depth to groundwater varies as a result of recharge, discharge, and tidal fluctuations from approximately 4.3 m at mean low tide to 1.7 m at mean high tide. Recharge to the groundwater comes from the infiltration of precipitation. Much of the shipyard is developed, resulting in reduced groundwater recharge in those areas. Groundwater outflow to the Piscataqua River and the estuary surrounding the island probably accounts for most of the natural discharge from Seavey Island. Leachate rates in disposal areas may increase where there is a significant tidal influence on the groundwater table, especially in highly permeable areas. There is no groundwater development or groundwater monitoring wells at the facility.

NOAA Trust Habitats and Species

Habitats of concern to NOAA are surface water and associated bottom substrates of the Piscataqua River and Portsmouth Harbor near Seavey Island. The shoreline of Seavey Island is predominantly bulkheaded along the southeast corner of the island. The remaining shoreline has areas of rock ledge, rocky beach, and intermittent

Table 1. Selected solid waste management units at PNSY.

Solid Waste Management Units	Period of Operation	Types of Waste Disposed
Industrial Waste Outfalls	1945 - 1975	Unspecified liquid industrial wastes were discharged into the Piscataqua River via sewer lines connected to three outfalls at Berths 6, 11, and 13.
DRMO Storage Yard (formerly DPDO)	1958-1986	Lead and nickel-cadmium battery elements, motors, scrap metal, typewriters, and paper products.
Jamaica Island Landfill	1945-1978	Plating sludges, asbestos insulation, VOCs, contaminated dredge spoils, acetylene and chlorine gas cylinders, waste paints and oils, and incinerator ash.
Mercury Burial Sites	1973-1975	Mercury-contaminated wastes in six concrete vaults.
Battery Acid Storage Tank 24	1974-1984 (Taken out of service in 1984 after 5-cm hole discovered; tank removed in 1986)	UST west of Berth 5 along Piscataqua River used to store waste battery acid and lead sludge from battery repair and submarine decommissioning; sulfuric acid contaminated with lead.
Jamaica Island Landfill Waste Oil Tanks	1943-present	Two 30,000-liter USTs used to store oily wastes prior to off-site disposal.
Boiler Blowdown Tank No. 25	1974-present	Located west of Dry Dock 2. UST used to collect and cool boiler blow-down water from power plant before discharged to sewer system; boiler water contains sodium sulfate, sodium hydroxide, and sodium phosphate.
Rinsewater Tank No. 27	1974-1989 (Pumped out in 1989)	UST received acidic rinsewater from two above-ground rinsewater tanks.
Rinsewater Tank No. 34	1974-1991 (Still in place, reportedly not cleaned out)	UST used to hold acidic rinsewater and metal residue from metal-descaling operation.
Acid/Alkaline Drain Tank No. 28	1974-? (No longer in use)	UST held variety of wastes, including acid and alkaline metal surface-cleaning residue and cyanide.
Chemical Cleaning Facility Tank No. 26	1974-1991 (Pumped out in 1991)	UST used to store waste acid and alkaline-metal, surface-cleaning solutions and solid residues.
Oil/Water Dumpsters	1960-present	About 40 dumpsters in three dry dock areas receive cleaning wastes from submarine bilges and various tanks.
Fuel Oil Spill	1973	No. 6 fuel oil pipeline ruptured; contaminated soil excavated.

patches of wetland (Grout personal communication 1993). The main channel of the Piscataqua River (along the southern shore of the island) averages approximately 20 m deep and approximately 250 to 800 m wide (NOAA 1991). Surface water of Portsmouth Harbor and the Piscataqua River surrounding Seavey Island have strong currents, ranging from 5 to 10 knots, and an average tidal amplitude of 2.7 m. The slower-moving Back Channel flows along the north side of the island. The Piscataqua River estuary is generally well mixed with a salinity gradient

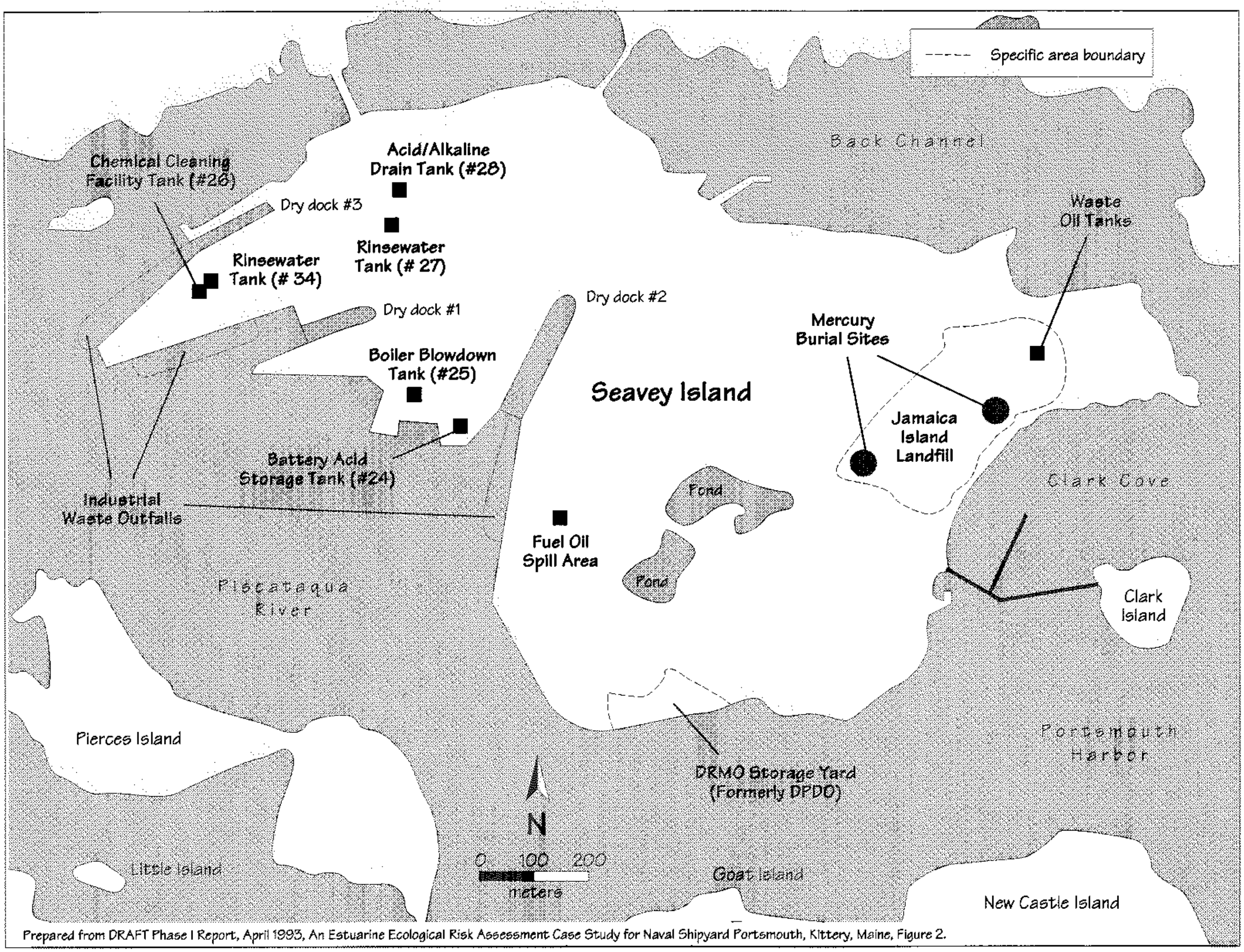

Figure 2. Detail of the Portsmouth Naval Shipyard site.

extending from the mouth of the harbor to the tributary rivers (TRC 1993). Salinities near the site commonly range from 27 to 34 ppt. Substrate at this reach of the river is primarily sand and mud (Grout personal communication 1993).

Near the site, the Piscataqua River and Portsmouth Harbor support diverse, abundant populations of NOAA trust resources (Table 2; Grout personal communication 1993). Numerous species migrate close to the site and reside for extended periods during sensitive life stages. Eleven species of anadromous fish migrate through the Piscataqua River. Although they have not been seen since the mid-1970s, the federally listed endangered shortnose sturgeon historically used the Piscataqua River near the site. Atlantic sturgeon, a species of concern in New Hampshire and Maine, may also inhabit surface water near the site. American shad and striped bass, both species of concern to the State of Maine, are seasonal inhabitants of nearshore water surrounding the site (Grout personal communication 1993).

Alewife, Atlantic silverside, Atlantic menhaden, blueback herring, and rainbow smelt are some of the most abundant finfish species found in the Piscataqua River system. These species represent important components of the forage base for larger predatory fish. Adult alewife and blueback herring commonly return to the Piscataqua River to spawn in upstream freshwater habitats from late April to mid-June. After spawning, adults return to marine environments by mid-July, while juveniles generally linger in the estuary before finally outmigrating by November. Atlantic silverside reside in the estuary year-round. Some menhaden spawn near the mouth of Portsmouth Harbor during June and July, although most individuals use the estuary only for foraging. Both adult and juvenile menhaden migrate offshore by September. Adult rainbow smelt enter the estuary in October and overwinter near the site. They generally spawn during April in small freshwater brooks and streams above the head of tide. Smelt generally migrate to offshore areas by May. Berrys Creek, approximately 3 km south of the site, provides important spawning and nursery habitat for populations of sea-run brown trout (Grout personal communication 1993).

Significant numbers of finfish are year-round residents near the site, including Atlantic tomcod, cunner, grubby, lumpfish, mummichog, northern searobin, northern pipefish, rock gunnel, smooth flounder, stickleback, and winter flounder. Major predators in the area include striped bass, bluefish, Atlantic tomcod, outmigrating juvenile Atlantic salmon, and American eel. Lobster, oyster, blue mussel, green crab, rock crab, and soft-shell clam abound in the estuary (Grout personal communication 1993).

Recreational fishing in Portsmouth Harbor and the Piscataqua River is primarily directed toward American shad, Atlantic tomcod, bluefish, lobster, oyster, pollock, rainbow smelt, sea-run brown trout, soft-shell clam, striped bass, white

Table 2. Major species that use the Piscataqua River near the site.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS/CATADROMOUS SPECIES						
Shortnose sturgeon	*Acipenser brevirostrum*			♦		
Atlantic sturgeon	*Acipenser oxyrhynchus*			♦		
Blueback herring	*Alosa aestivalis*		♦	♦	♦	
Alewife	*Alosa pseudoharengus*		♦	♦	♦	
American shad	*Alosa sapidissima*		♦	♦		♦
American eel	*Anguilla rostrata*		♦	♦	♦	
White perch	*Morone americana*		♦	♦		♦
Striped bass	*Morone saxatilis*			♦		♦
Chinook salmon[1]	*Oncorhynchus tshawytscha*		♦	♦		
Rainbow smelt	*Osmerus mordax*		♦	♦	♦	♦
Sea lamprey	*Petromyzon marinus*		♦	♦		
Atlantic salmon	*Salmo salar*		♦	♦		
Sea-run brown trout[2]	*Salmo trutta*		♦	♦		♦
MARINE SPECIES						
American sandlance	*Ammodytes americanus*			♦		
Atlantic menhaden	*Brevoortia tyrannus*	♦	♦	♦	♦	
Black sea bass	*Centropristis striata*			♦		
Atlantic herring	*Clupea harengus*		♦	♦		
Banded killifish	*Fundulus diaphanus*	♦	♦	♦		
Mummichog	*Fundulus heteroclitus*	♦	♦	♦		
Atlantic cod	*Gadus morhua*			♦		
Stickleback	*Gasterosteus spp.*	♦	♦	♦		
Smooth flounder	*Liopsetta putnami*	♦	♦	♦		
Atlantic silverside	*Menidia menidia*	♦	♦	♦	♦	
Atlantic tomcod	*Microgadus tomcod*	♦	♦	♦		♦
Grubby	*Myoxocephalus aenaeus*	♦	♦	♦		
Lumpfish	*Cyclopterus lumpus*	♦	♦	♦		
Rock gunnel	*Pholis gunnellus*	♦	♦	♦		
Pollock	*Pollachius virens*		♦			♦
Bluefish	*Pomatus saltatrix*		♦	♦		3
Northern searobin	*Prionotus carolinus*	♦	♦	♦		
Winter flounder	*Pseudopleuronectes americanus*	♦	♦	♦		♦
Little skate	*Raja erinacea*			♦		
Winter skate	*Raja ocellata*			♦		
Windowpane	*Scophthalmus aquosus*			♦		
Northern pipefish	*Syngnathus fuscus*	♦	♦	♦		
Cunner	*Tautogolabrus adspersus*	♦	♦	♦		♦
Red hake	*Urophycis chuss*			♦		
White hake	*Urophycis tenuis*			♦		

1: Species are propagated through stocking program.
2: Spawning occurs primarily in Berrys Creek (Grout personal communication 1993).
3: A general health advisory recommends limiting consumption of bluefish inhabiting or originating from the Mid-Atlantic Bight due to excessive concentrations of PCBs (Grout personal communication 1993).

Table 2., cont.
Major species that use the Piscataqua River near the site.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
INVERTEBRATE SPECIES						
Atlantic rock crab	*Cancer irroraute*	♦	♦	♦	♦	
Green crab	*Carcinus maenas*	♦	♦	♦		
American oyster	*Crassostrea virginica*	♦	♦	♦		4
Shrimp	*Crangon spp.*		♦			
Lobster	*Homarus americanus*		♦	♦	♦	4
Horseshoe crab	*Limulus polyphemus*	♦	♦	♦		
Hard shell clam	*Mercenaria mercenaria*	♦	♦	♦		
Soft shell clam	*Mya arenaria*	♦	♦	♦		4
Blue mussel	*Mytilus edulis*	♦	♦	♦		4
Deep sea scallop	*Placopecten magellanicus*		♦	♦	4	
Atlantic razor clam	*Siliqua costata*	♦	♦	♦		
Surf clam	*Spisula solidissima*	♦	♦	♦		

4: Except in Great Bay, no bivalve harvesting is permitted in the Piscataqua watershed due to excess levels of fecal coliform (Grout personal communication 1993).

perch, and winter flounder. Striped bass is the favored recreational species in the area; this fishery generally extends from May through October. Angling for sea-run brown trout is permitted from mid-October through late December. There is recreational shellfishing for blue mussel, oyster, and soft-shell clam in Great Bay (Grout personal communication 1993).

Lobstering is the largest commercial activity near the site, with a year-round rock crab fishery in the harbor. There is some harvesting of deep sea scallop near the mouth of the harbor. Because fishing gear classified as "movable tackle" is prohibited in New Hampshire and Maine inland waters, there are only small, isolated commercial finfish fisheries in Portsmouth Harbor and the Piscataqua River near the site. Commercial potting and spear fishing for American eel is common in the spring and summer. There is a small cast-net fishery for Atlantic silverside in the harbor and some gill-netting for bluefish and menhaden at the mouth of the harbor.

The menhaden fishery is primarily used as bait by striped bass, bluefish, and lobster harvesters. Rainbow smelt are targeted both commercially and recreationally primarily by hook-and-line tackle and some limited use of bow-nets. Alewife and blueback herring also constitute a commercial gill-net fishery during seasonal runs (Grout personal communication 1993)

The Great Bay Estuary is a large estuarine water embayment that is designated as a National Research Reserve under the National Estuary Program. The estuary joins the Piscataqua River via a smaller embayment, Little Bay, approximately 15 km upstream from the site. Numerous tributaries provide habitat to several anadromous trust resources; the largest of these are the Lamprey and the Squamscott rivers, which discharge into Great Bay approximately 15 km and 16 km upstream from the site, respectively. A third important tributary of the Piscataqua River, with established anadromous runs, is the Cocheco River, joining the Piscataqua River approximately 16 km upstream from the site.

Several restoration programs focus on the Lamprey, the Exeter (the upper reach of the Squamscott River), and the Cocheco rivers. Between 1,000 and 1,500 spawning American shad are transported annually via truck from the Merrimack River in Massachusetts for release into the Exeter River. An Atlantic salmon restoration program annually releases between 200,000 and 300,000 Atlantic salmon fry, parr, and smolt into the Lamprey and Cocheco rivers. Since the mid-1980s, a chinook salmon stocking program has annually released approximately 400,000 smolts into the Lamprey River. The chinook salmon program is being evaluated to determine whether stocking efforts should continue. Approximately 5,000 sea-run brown trout yearlings are released each spring into Berrys Creek (Grout personal communication 1993).

A general health advisory recommends limited consumption of bluefish inhabiting or originating from the Mid-Atlantic Bight due to excessive PCB concentrations. Due to fecal coliform contamination, recreational and commercial harvesting of bivalves are prohibited within the Piscataqua watershed except for the surface waters of Great Bay (Grout personal communication 1993).

Sensitive habitats near the site include the Great Bay National Wildlife Reserve and the Rachel Carson National Wildlife Reserve. The Great Bay National Wildlife Reserve, situated along the Great Bay Estuary, provides habitat to numerous threatened and endangered species of plant and terrestrial wildlife. The Rachel Carson Wildlife Refuge, approximately 5 km east of the shipyard, primarily contains salt marsh and upland areas. No information regarding resource use of the refuge was available.

Harbor seals (*Phoca vitulina*) inhabit surface water surrounding the site during the winter months. Federally listed endangered whales are frequently seen just offshore in the Atlantic Ocean during seasonal migrations. These include humpback (*Megaptera noveangliae*), northern right (*Eubalaena glacialis*), finback (*Balaenoptera physalus*), and minke (*Balaenoptera acutorostrata*). Atlantic pilot whales (*Globicephala melaena*) rarely migrate into the Piscataqua River to forage (Grout personal communication 1993).

Site-Related Contamination

Data collected during site investigations indicate that soil, sediments, and surface water at the shipyard contain elevated concentrations of site-related contaminants. Cadmium (23 mg/kg), chromium (170 mg/kg), lead (147,000 mg/kg), and nickel (16,000 mg/kg) were detected in soil samples collected at the Defense Reutilization and Marketing Office storage yard at concentrations far above their respective averages for U.S. soils (Loureiro 1985). Though completed in 1992 along with an addendum in 1993, an extensive soil and groundwater investigation conducted as part of the RCRA Facility Investigation was not available for this review.

The U.S. Navy and the U.S. Environmental Protection Agency conducted research in the Great Bay and Piscataqua River Estuary, and produced an estuarine ecological risk assessment for the shipyard (NCCOSC et al. 1993). Phase 1 of this study distinguished important ecological resources in the estuary and identified areas that appear to be under ecological stress. Table 3 shows maximum concentrations of contaminants detected in sediment and surface water collected during the risk assessment, and the screening guidelines used to evaluate these concentrations. Concentrations of copper, lead, mercury, zinc, phenanthrene, anthracene, fluoranthene, chrysene, benzo(a)pyrene, total PAHs, and PCBs in sediments each exceeded ERM screening guidelines. Clark Cove, near the Jamaica Island Landfill, represents an area of sediment deposition due to its location outside of the main flow of tidal currents. Clark Cove sediments had the highest or second highest concentrations for nearly all analytes, and sediments from the cove had the finest texture of all stations sampled. Sediments from the Clark Cove, Back Channel, and CIA/dry dock stations each contained contaminants at concentrations exceeding those shown to be toxic to aquatic organisms in other studies.

Cadmium, chromium, copper, mercury, nickel, and zinc were detected in water samples collected from seeps near the Jamaica Island Landfill at concentrations exceeding marine chronic AWQC. Copper, mercury, and nickel were detected in water next to Seavey Island at concentrations exceeding marine AWQC (Table 3).

The ecological risk assessment included an investigation of contamination in tissue of both deployed and indigenous mussels. Contaminant concentrations measured in indigenous mussels were similar to those in deployed mussels. For indigenous mussels, the highest concentrations of chromium, nickel, silver, PAHs, and PCBs were measured in animals collected from the Upper Piscataqua River and Little Bay. The highest concentrations of lead were measured in mussels collected from the main channel near the island. Concentrations of lead and chromium in indigenous mussel tissues were elevated 2 to 11 times expected background concentrations. Concentrations of mercury in mussels collected from stations in the Great Bay Estuary were above background concentrations.

Summary

Trace elements, PCBs, and PAHs have been detected in soil, sediment, and surface water associated with the shipyard at concentrations that may pose a risk to NOAA trust resources. Sediment depositional areas next to Seavey Island

Table 3. Maximum concentrations of selected analytes in sediment and surface water at PNSY.

	Sediment (mg/kg)				Surface Water (ug/l)			
Analyte	Grab[1]	Core[1]	ERL[2]	ERM[3]	River	Seep	Freshwater AWQC[4]	Marine AWQC[4]
TRACE ELEMENTS								
Arsenic	29	18	8.2	70	4.0	7.0	190	36
Cadmium	2.0	1.1	1.2	9.6	9.0	13	1.1+	9.3
Chromium	210	340	81	370	16	310	11	50
Copper	91	530	34	270	300	3100	12+	2.9
Lead	120	420	46.7	223	3.0	3.0	3.2+	8.5
Mercury	0.58	1.9	.15	0.71	17	320	0.12+	0.025
Nickel	1.1	1.3	20.9	51.6	46	15	160+	8.3
Zinc	380	2000	150	410	18	220	110+	86
PAHs								
Anthracene	0.65	1.9	0.085	1.1	NA	ND	NA	NA
Benzo(a)pyrene	0.86	2.3	0.43	1.6	NA	ND	NA	NA
Benzo(e)pyrene	0.58	1.9	NA	NA	NA	ND	NA	NA
Chrysene	1.3	3.2	0.384	2.8	NA	ND	NA	NA
Fluoranthene	1.8	14	0.60	5.1	NA	ND	NA	p16
Fluorene	0.25	0.28	0.019	0.54	NA	ND	NA	NA
Phenanthrene	1.6	6.2	0.24	1.5	NA	ND	6.3p	4.6p
Pyrene	1.5	10	0.665	2.6	NA	ND	NA	NA
Total PCBs	0.47	0.11	0.0227	0.18	NA	ND	0.014	0.03
PESTICIDES								
p,p-DDD	0.018	0.062	0.002	NA	NA	ND	NA	NA
p,p-DDE	0.0059	0.016	0.002	NA	NA	ND	NA	NA

1: Core samples taken at unknown subsurface depth. Grab samples generally taken at surface.
2: Effects range low; the concentration representing the lowest 10-percentile value for the data in which effects were observed or predicted in studies compiled by Long and MacDonald (1992).
3: Effects range median (Long and MacDonald 1992).
4: Ambient water quality criteria for protection of aquatic organisms. Freshwater and marine chronic presented (U.S. EPA 1993).
+: Value is dependent on hardness (100 mg $CaCO_3$ mg/l used).
p: Proposed value.
NA: Not analyzed or not available.
ND: Not detected.

are of particular concern, especially in the Clark Cove and the Back Channel areas. Of the current major contaminant sources on the island, the Jamaica Island Landfill and the Defense Reutilization and Marketing Office Storage Yard probably pose the most significant risks to aquatic biological receptors because of their elevated contaminant concentrations and proximity to the Piscataqua River and Portsmouth Harbor. Both of these habitats support diverse, abundant populations of NOAA resources.

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1

South Weymouth Naval Air Station

Plymouth and Norfolk Counties, Massachusetts
CERCLIS #MA2170022022

Site Exposure Potential

South Weymouth Naval Air Station (NAS SOWEY) occupies approximately 580 hectares in Plymouth and Norfolk counties in eastern Massachusetts approximately 24 km south of Boston and 10 km from the Atlantic coast (Halliburton NUS 1994; Figure 1). The station is situated approximately 4 km upstream from Whitmans Pond, and 16 km upstream from Indian Head River, both NOAA trust habitats. The station consists of the main station and four smaller remote areas. The main station, the focus of site investigations, was developed during the 1940s as a Lighter-than-Air facility for dirigible aircraft used to patrol the North Atlantic during World War II. The four remote areas associated with the site are not discussed in site-related documents. The station was closed at the end of the war, and reopened in 1953 as a Naval Air Station aviation training facility. Since that time, the facility has operated continuously. The station currently provides administrative coordination and logistical support for the Naval Air Reserve Training Detachment South Weymouth and performs functions directed by the Chief of Naval Operations (Halliburton NUS 1994).

As part of the Installation Restoration Program (IRP), the U.S. Navy's environmental program, Site Investigations were conducted at eight NAS

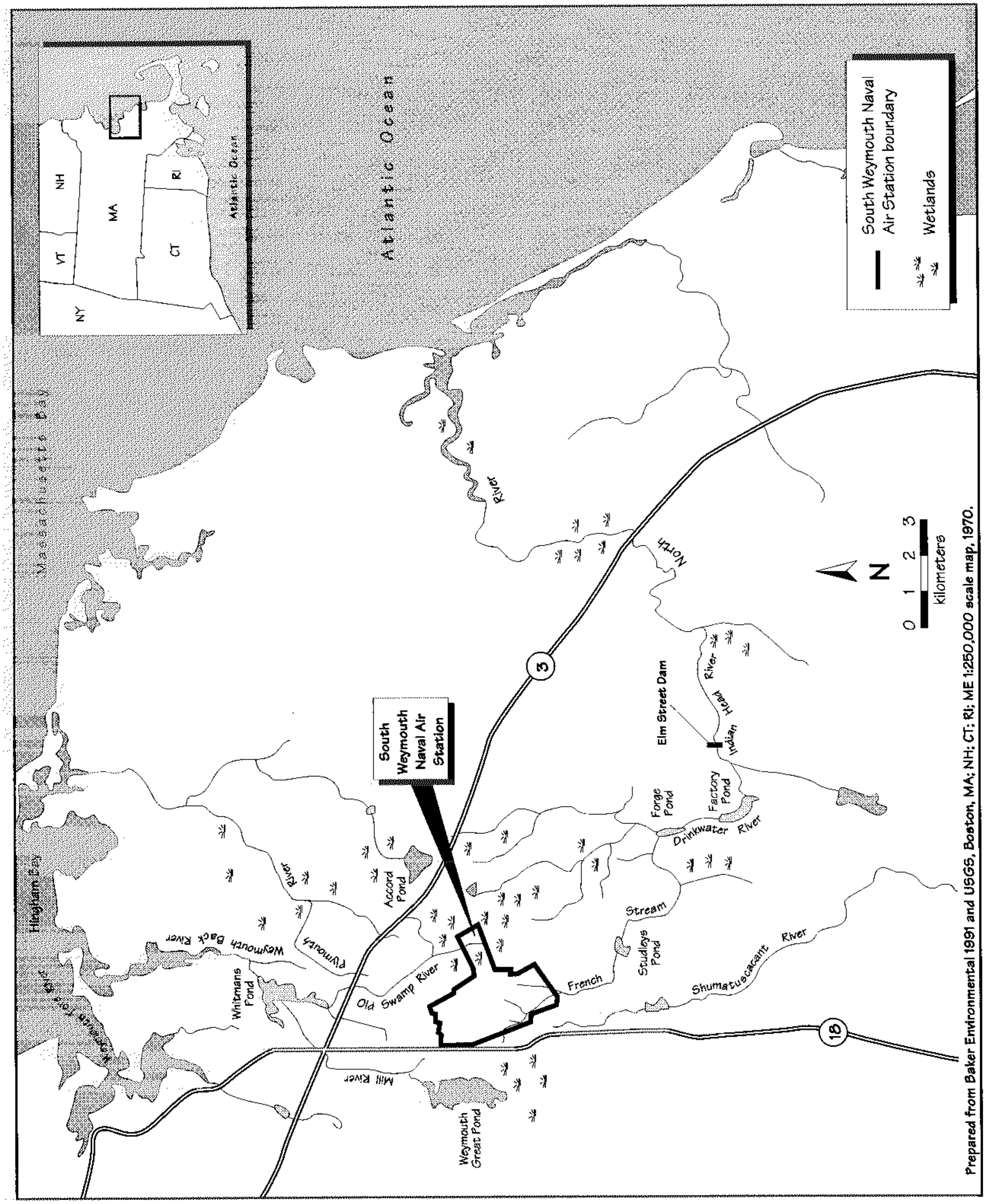

Figure 1. Location of the South Weymouth Naval Air Station in Massachusetts.

SOWEY sites previously identified as potential sources of contamination (Baker 1991). Primary wastes generated at the station throughout its operation included domestic waste, oils and hazardous materials, and sewage. The period of operation, types of waste disposed, and the chemicals of concern at each of these sites are presented in Table 1. Based on the operating history of the Sewage Treatment Plant, only a file review was conducted during the Site Investigation and no samples were collected. Sampling of environmental media at the Sewage Treatment Plant is proposed for future investigations at the site (Halliburton NUS 1994).

The station produces between 100 and 1,000 kg of hazardous waste per month. The station annually generates 12,000 l of waste engine oil, 4,100 l of waste hydraulic fluid, 12,000 l of waste solvents, and 630 l of waste transmission fluids, which are stored temporarily on site and later transported offsite to a hazardous waste disposal facility. There are no active landfills at the station. Since 1972, all solid, non-hazardous waste and garbage have been disposed offsite at a sanitary landfill (Baker 1991).

Several releases of hazardous materials have been documented at the station. In 1986, approximately 22,700 l of JP-5 jet fuel were spilled at an unidentified on-site location. In addition, oil containing PCBs was released from a transformer in 1986. PCB-contaminated soil was collected in the area of the spill and removed to an offsite disposal facility (Baker 1991).

The surface terrain around the station varies from relatively flat to rolling land and is characterized by bedrock outcrops, wetlands, and small stream channels. The station contains both urban and forested areas (Halliburton NUS 1994). Station elevation ranges from approximately 4 to 55 m above sea level, with a slope of usually less than 5 percent (Argonne National Laboratories 1988).

Surface runoff and groundwater migration are the potential pathways of contaminant transport from the station to NOAA trust resources and habitats. A surface water divide at NAS SOWEY directs runoff into two drainage basins. Surface and storm drainage water on western portions of the station enter a ditch system that flows southward into French Stream. Surface and storm drainage water on the northern and eastern portions of the station enter a ditch system that flows northward into Old Swamp River, and subsequently into the Weymouth Back River. Only shallow groundwater movement was discussed in the site-related documents; its movement at the station is complex and multidirectional. In general, shallow groundwater in the western part of the station probably discharges to Old Swamp River, while shallow groundwater in eastern portions of the station discharges to French Stream (Halliburton NUS 1994).

Table 1. Site description and associated wastes for eight sites evaluated at NAS SOWEY.

Site Name	Period of Operation	Waste Type	Size of Area (ha)	Chemicals of Concern
West Gate Landfill (WGL)	1969-1972	Domestic waste and debris	2	Trace elements, PAHs
Rubble Disposal Area (RDA)	c.1972-1980s	Building debris	1.5	Trace elements, PAHs, aldrin
Small Landfill (SL)	c.1972-1980's	Concrete rubble, tree stumps	0.8	Trace elements, PAHs
Fire Fighting Training Area (FFTA)	1950s-1986 1988-present	Jet fuels, waste oils	1.5	Trace elements, PAHs
Tile Leach Field (TLF)	1945-1968	Sanitary waste, battery acid	0.3	Trace elements, PAHs, aldrin
Fuel Tank Farm (FTF)	unknown	Oil and hazardous materials (OHM)	1.6	Trace elements, PAHs, aldrin
Sewage Treatment Plant	1956-1978	Sewage	0.04	Unknown
Abandoned Bladder-Tank Fuel Storage Area (ABTFS)	until 1987	JP-5 jet fuel	0.5	Trace elements, PAHs, aldrin

NOAA Trust Habitats and Species

Habitats of concern to NOAA are surface water and associated bottom substrates of the Indian Head River, North River, Old Swamp River, Whitmans Pond, and the Weymouth Back River, all used by anadromous species. Secondary habitats of concern to NOAA include surface water and associated bottom substrates of Hingham Bay.

Surface water associated with the station flows into two drainage basins (Figures 1 and 2). Northern and eastern portions of the station drain into the Old Swamp River, which discharges into Whitmans Pond. The Weymouth Back River, the drainage outlet of Whitmans Pond, discharges into Hingham Bay further downstream, which adjoins Massachusetts Bay. Southern and western portions of the station are drained by French Stream, which subsequently joins the Drinkwater River, and later the Indian Head River. The Indian Head River joins the North River. Lower portions of the Weymouth Back River and the North River are estuarine habitats.

Several anadromous species ascend the Weymouth Back River and North River for spawning. Runs of alewife, American shad, blueback herring, rainbow smelt, white perch,

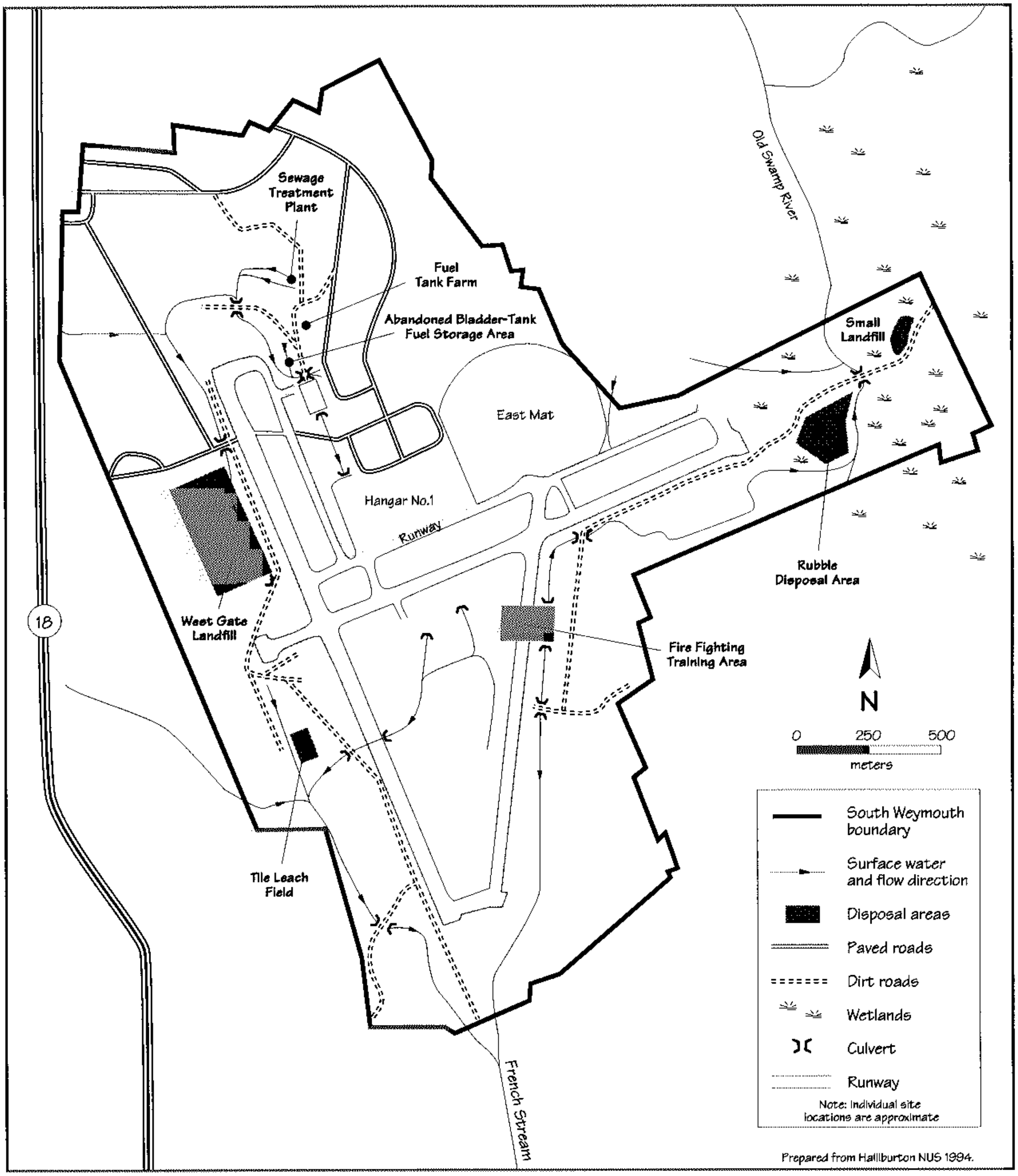

Figure 2. Site features at the South Weymouth Naval Air Station in Massachusetts.

and sea lamprey are present in both systems (Table 2). Alewife migrate the furthest upstream of the anadromous species, but they are restricted by the Elm Street dam in the Indian Head River, approximately 16 km downstream from the station. American shad and blueback herring use habitats further downstream for spawning. In the Weymouth Back River watershed, a large run of alewife returns annually to spawn in Whitmans Pond, approximately 4 km downstream from the station. Although unconfirmed, some adults may migrate upstream from the pond to spawn in the Old Swamp River near the station (Reback personal communication 1994).

Table 2.
Major species that use the Weymouth Back River and North River drainages downstream from the site.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS/CATADROMOUS SPECIES						
Blueback herring	*Alosa aestivalis*	♦	♦	♦		
Alewife	*Alosa pseudoharengus*	♦	♦	♦		♦
American shad	*Alosa sapidissima*	♦	♦	♦		♦
American eel	*Anguilla rostrata*		♦	♦		
White perch	*Morone americana*	♦	♦	♦		
Striped bass	*Morone saxatilis*		♦	♦		♦
Rainbow smelt	*Osmerus mordax*	♦	♦	♦		♦
Sea lamprey	*Petromyzon marinus*		♦	♦		
MARINE SPECIES						
4-spine stickleback	*Apeltes quadracus*	♦	♦	♦		
Atlantic menhaden	*Brevoortia tyrannus*	♦	♦	♦		
Mummichog	*Fundulus heteroclitus*	♦	♦	♦		
Striped killifish	*Fundulus majalis*	♦	♦	♦		
3-spine stickleback	*Gasterosteus aculeatus*	♦	♦	♦		
Atlantic silverside	*Menidia menidia*	♦	♦	♦		
Atlantic tomcod	*Microgadus tomcod*	♦	♦	♦		
Longhorn sculpin	*Myoxocephalus octodecemspinosus*	♦	♦	♦		
Bluefish	*Pomatus saltatrix*		♦	♦		1
Northern searobin	*Prionotus carolinus*	♦	♦	♦		
Winter flounder	*Pseudopleuronectes americanus*	♦	♦	♦		
INVERTEBRATE SPECIES						
Green crab	*Carcinus maenas*	♦	♦	♦		
Blue crab	*Callinectes sapidus*	♦	♦	♦		♦
Common spider crab	*Libinia emarginata*	♦	♦	♦		
Quahog	*Mercenaria mercenaria*	♦	♦	♦		2
Soft shell clam	*Mya arenaria*	♦	♦	♦		2
Blue mussel	*Mytilus edulis*	♦	♦	♦		2

1: A general health advisory recommends limited consumption of bluefish inhabiting or originating from water of the mid-Atlantic Bight due to excessive concentrations of PCBs in their tissue (Reback personal communication 1994).
2: Harvesting of bivalves is prohibited due to potential fecal coliform contamination from urban runoff (Churchill personal communication 1994).

Alewife, blueback herring, and American shad generally enter freshwater aquatic habitats associated with the station to spawn in suitable upstream environments from March through May. Juveniles normally return to the ocean by the following fall. Sea lamprey on the northern Atlantic seaboard return to fresh water to spawn in the spring, but spend the majority of their life at sea. Adult rainbow smelt enter the estuarine water of Weymouth Back River and North River in October for overwintering, then later spawn in small freshwater brooks and streams above the head of tide during the spring. Smelt commonly migrate to offshore areas by May (Reback personal communication 1994).

Species using estuarine habitats of the Weymouth Back River and the North River on a year-round basis in greatest densities include Atlantic silverside, threespine and fourspine stickleback, killifish, longhorn sculpin, and northern searobin. Atlantic menhaden, bluefish, and striped bass frequently enter the estuaries to forage. Winter flounder and Atlantic tomcod spawn in the estuaries and later migrate into more saline water. The catadromous American eel is found throughout the area (Reback personal communication 1994). This is the only NOAA trust species capable of migrating upstream of the Elm Street Dam on the Indian Head River. There are populations of blue crab, blue mussel, green crab, quahog, and soft-shell clam in lower portions of the Weymouth Back River and North River (Churchill personal communication 1994).

There are no commercial fisheries in the Weymouth Back River and North River drainages. There is some recreational fishing directed primarily toward American shad, bluefish, and striped bass in these rivers. Alewife and rainbow smelt are also commonly harvested during seasonal migratory runs in the spring. There is also moderate recreational fishing for blue crab. Harvesting bivalves from the Weymouth Back River and North River systems is prohibited because of the potential threat of fecal coliform contamination associated with urban runoff (Churchill personal communication 1994).

A general health advisory recommends limited consumption of bluefish inhabiting or originating from the Mid-Atlantic Bight because of excessive concentrations of PCBs in their tissue.

Site-Related Contamination

In 1991, 12 sediment, 39 soil, 20 groundwater, and 12 surface water samples were collected from on-site locations as part of the IRP Site Investigations (Baker 1991). Environmental samples were collected from seven of the potential source areas: the West Gate Landfill, Rubble Disposal Area, Small Landfill, Fire Fighting Training Area, Tile Leach Field, Fuel Tank Farm, and the Abandoned Bladder-Tank Fuel Storage Area.

All sediment, soil, groundwater, and surface water samples were analyzed for all parameters on EPA's Target Compound List/Target Analyte List. In addition, groundwater samples were analyzed for dissolved metals and surface water samples were analyzed for total metals. Samples from selected sites were analyzed for TPH, oil and grease, and sulfate.

Trace elements and PAHs are the primary contaminants of concern to NOAA. Aldrin, a pesticide, was detected at three of the six waste sites sampled. PCBs and numerous additional VOCs and SVOCS are also known to have been used and handled at the station. VOCs and SVOCS detected at concentrations exceeding screening guidelines are presented in Table 3. No PCBs were detected in on-site media; detection limits were not provided in documentation reviewed.

Trace elements were detected in some areas at elevated concentrations in soils, sediments, surface water, and groundwater. Lead was detected in soil samples collected from the Rubble Disposal Area (31 mg/kg) and the Fire Fighting Training Area (29 mg/kg), but concentrations were only slightly above average U.S. soil concentrations for this trace element (16 mg/kg). Zinc was detected in soil samples collected from the Small Landfill (75 mg/kg); the highest measured concentrations of zinc exceeded the average U.S. soil screening guidelines (48 mg/kg). Silver (in samples collected from the Small Landfill and the Fire Fighting Training Area) was the only trace element detected in groundwater at a concentration above its freshwater chronic AWQC (U.S. EPA 1993) by a factor greater than ten. Lead (in samples collected from the Rubble Disposal Area and the Fire Fighting Training Area) and zinc (in samples collected from the Fire Fighting Training Area) were the only trace elements detected in sediment samples at concentrations exceeding their respective ERL screening guidelines (Long and MacDonald 1992; Table 3). The concentration of zinc also exceeded its ERM screening guideline (Long and MacDonald 1992). Lead, silver, and zinc were detected in surface water samples collected from the Fire Fighting Training Area at concentrations exceeding their respective AWQC screening guidelines (Table 4).

Acenaphthene, anthracene, benz(a)anthracene, chrysene, fluoranthene, phenanthrene, pyrene, and 2-methylnaphthalene were detected in sediment samples collected from the Abandoned Bladder-Tank Fuel Storage Area and Fuel Tank Farm at concentrations exceeding their respective ERL screening guidelines (Table 3). The Rubble Disposal Area was the only on-site area that contained a PAH (phenanthrene) at a concentration (260 µg/kg) exceeding the ERL screening guideline. PAHs were detected infrequently in groundwater samples and did not exceed the AWQC screening guideline by a factor greater than ten. Only a limited distribution of PAHs was detected in on-site soil samples. The highest concentrations of PAHs in soils were measured in one sample collected from the Rubble Disposal Area. Maximum soil concentrations of PAHs in this area included acenaphthene (110 µg/kg), anthracene (210 µg/kg), benz(a)anthracene

(750 µg/kg), chrysene (1,100 µg/kg), fluoranthene (1,900 µg/kg), phenanthrene (1,200 µg/kg), and pyrene (1,200 µg/kg).

Aldrin, the only pesticide reportedly detected in on-site media, was found only in the sediment samples collected from the West Gate Landfill (48 µg/kg), Tile Leach Field (48 µg/kg), and Abandoned Bladder-Tank Fuel Storage Area-Fuel Tank Farm (130 µg/kg). No sediment concentration screening guidelines have been developed for this pesticide.

Table 3. Maximum concentrations of contaminants of concern detected in sediment samples collected from waste sites located at NAS SOWEY.

Contaminants	Sediment						Screening Guidelines	
	WGL	RDA	SL	FFTA	TLF	ABTFS-FTF[1]	ERL[2]	ERM[3]
INORGANIC SUBSTANCES (mg/kg)								
Lead	10	70	NS	150	NR	10	46.7	218
Silver	NR	ND	NS	NR	NR	NR	1.0	3.7
Zinc	NR	NR	NS	810	NR	NR	150	410
ORGANIC COMPOUNDS (µg/kg)								
PAHs								
Acenaphthene	NR	NR	NS	NR	NR	150	16	500
Anthracene	NR	NR	NS	NR	NR	240	85.3	1,100
Benz(a)anthracene	NR	NR	NS	NR	NR	530	260	1,600
Chrysene	NR	NR	NS	NR	NR	550	380	2,800
Fluoranthene	NR	280	NS	NR	NR	1,300	600	5,100
Naphthalene	NR	NR	NS	ND	NR	100	160	2,100
Phenanthrene	NR	260	NS	NR	NR	1,400	240	1,500
Pyrene	NR	260	NS	NR	NR	1,400	670	2,600
2-Methylnaphthalene	NR	NR	NS	NR	NR	790	70	670
ORGANOCHLORINE COMPOUNDS								
Aldrin (µg/kg)	NR	48	NS	NR	48	130	NA	NA

1: Although the ABTFS and the FTF are separate waste sites, contaminant information for these areas was provided in the site-related documents as combined data sets.
2: Effects range-low; the concentration representing the lowest 10-percentile value for the data in which effects were observed or predicted in studies compiled by Long and MacDonald (1992).
3: Effects range-median (Long and MacDonald 1992).
NA: Screening guidelines not available.
ND: Not detected; detection limit not available.
NR: Not reported.
NS: Not sampled.

Table 4. Maximum concentrations of contaminants of concern detected in surface water (µg/l) samples collected from waste sites located at NAS SOWEY.

Contaminants	Surface Water						Freshwater AWQC[1]	
	WGL	RDA	SL	FFTA	TLF	ABTFS FTF	Chronic	Acute
INORGANIC SUBSTANCES								
Lead	6.1	5.4	NR	11	ND	5.8	3.2+	83+
Silver	ND	23	NR	ND	ND	ND	0.12	4.1+
Zinc	ND	ND	NR	154	ND	ND	110+	120+
ORGANIC COMPOUNDS								
PAHs								
Naphthalene	ND	ND	NR	2[2]	ND	ND	620[2]	2300[2]

1: Ambient water quality criteria for the protection of aquatic organisms (U.S. EPA 1993).
2: Lowest observed effects levels.
ND: Not detected; detection limit not available.
NR: Not reported.
+: Value is dependent on hardness (100 mg/l $CaCO_3$ assumed).

Summary

Trace elements and PAHs have been detected in soil, surface water, sediment, and groundwater samples collected from seven of the hazardous waste sites associated with NAS SOWEY. Preliminary data show that contaminants are present at concentrations marginally exceeding those shown to be toxic to NOAA trust resources. Anadromous trust resources are known to use Whitmans Pond and the Indian Head River, approximately 4 km and 16 km downstream from the station, respectively. In addition, American eel may inhabit on-site surface water of French Stream and the Old Swamp River. No conclusions about the overall risk posed by the facility to resources of concern to NOAA can be made until the extent of contaminant migration from the station is known.

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1

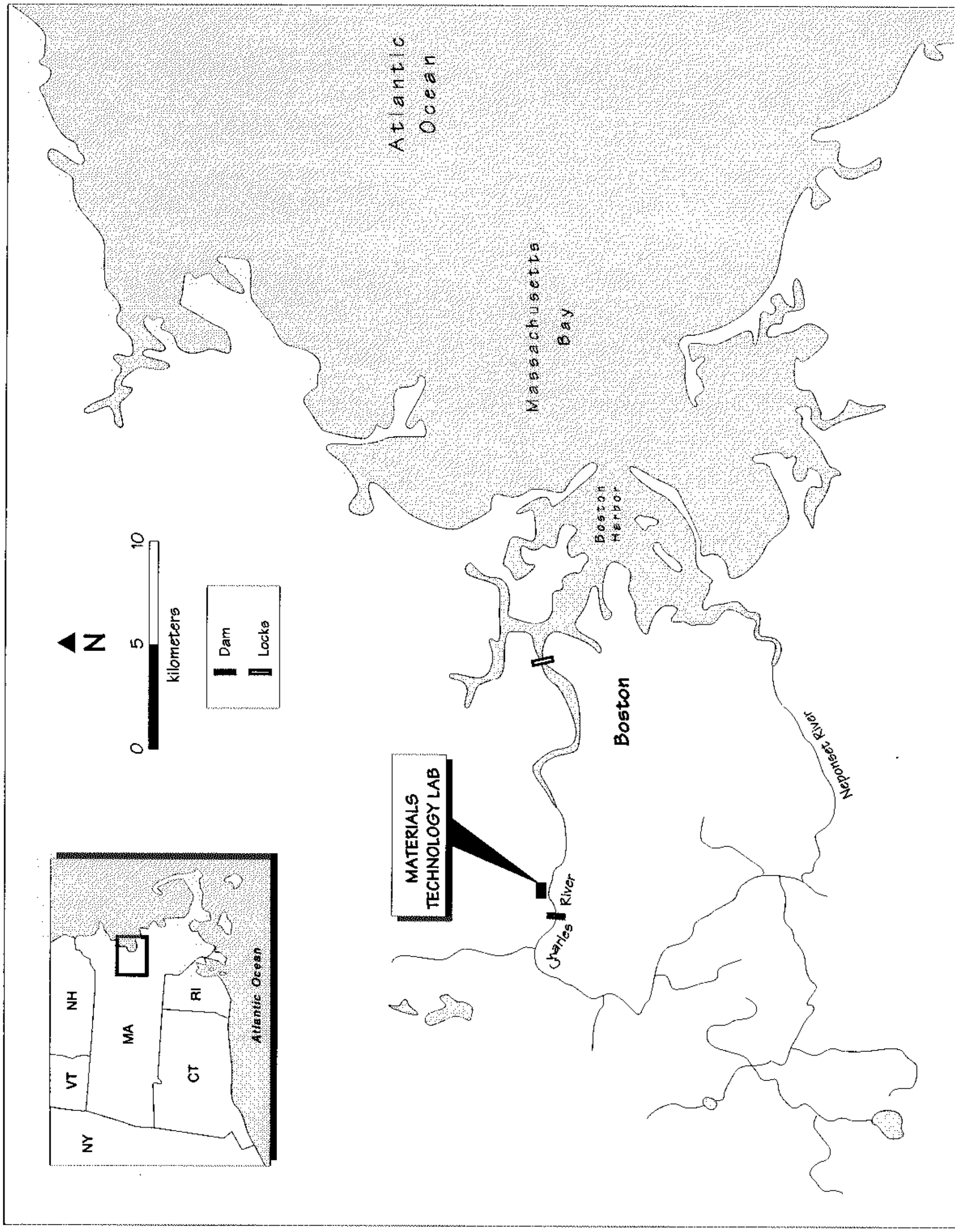
U.S. Army Materials Technology Laboratory

Watertown, Massachusetts
CERCLIS #MA0213820939

Site Exposure Potential

The U.S. Army Materials Technology Laboratory (MTL) covers 19 hectares along the northern bank of the Charles River in Watertown, Massachusetts, a suburb of Boston. The Charles River flows through Boston before discharging into Boston Harbor, approximately 14 km from the site. Boston Harbor is a coastal embayment of Massachusetts Bay, the region in the Atlantic Ocean located north of Cape Cod (Figure 1).

The MTL facility engaged in ammunition and pyrotechnics production, material testing, and experimentation with paint, lubricants, and cartridges from 1816 until World War II. At the height of its activity, the facility encompassed 53 hectares, contained 53 buildings, and employed 10,000 people. The site was also the location of a research nuclear reactor from 1960 until 1970. Today MTL's mission is materials research and development, weapons and ammunition development and production, solid mechanics, testing technology, and lightweight armor development. Sources of contamination are improper handling, storage, and disposal of hazardous materials related to past site activities (no specific activities were addressed in the documents reviewed). Although a portion of the site was allegedly used for landfilling (Site 2, Figure 2), the amount and types of materials



Prepared from Atlantic Coast Ecological Inventory, 1:250 000 scale, Boston, MA; CT; ME; NH (1980).

Figure 1. Location of Materials Technology Lab in Watertown, Massachusetts.

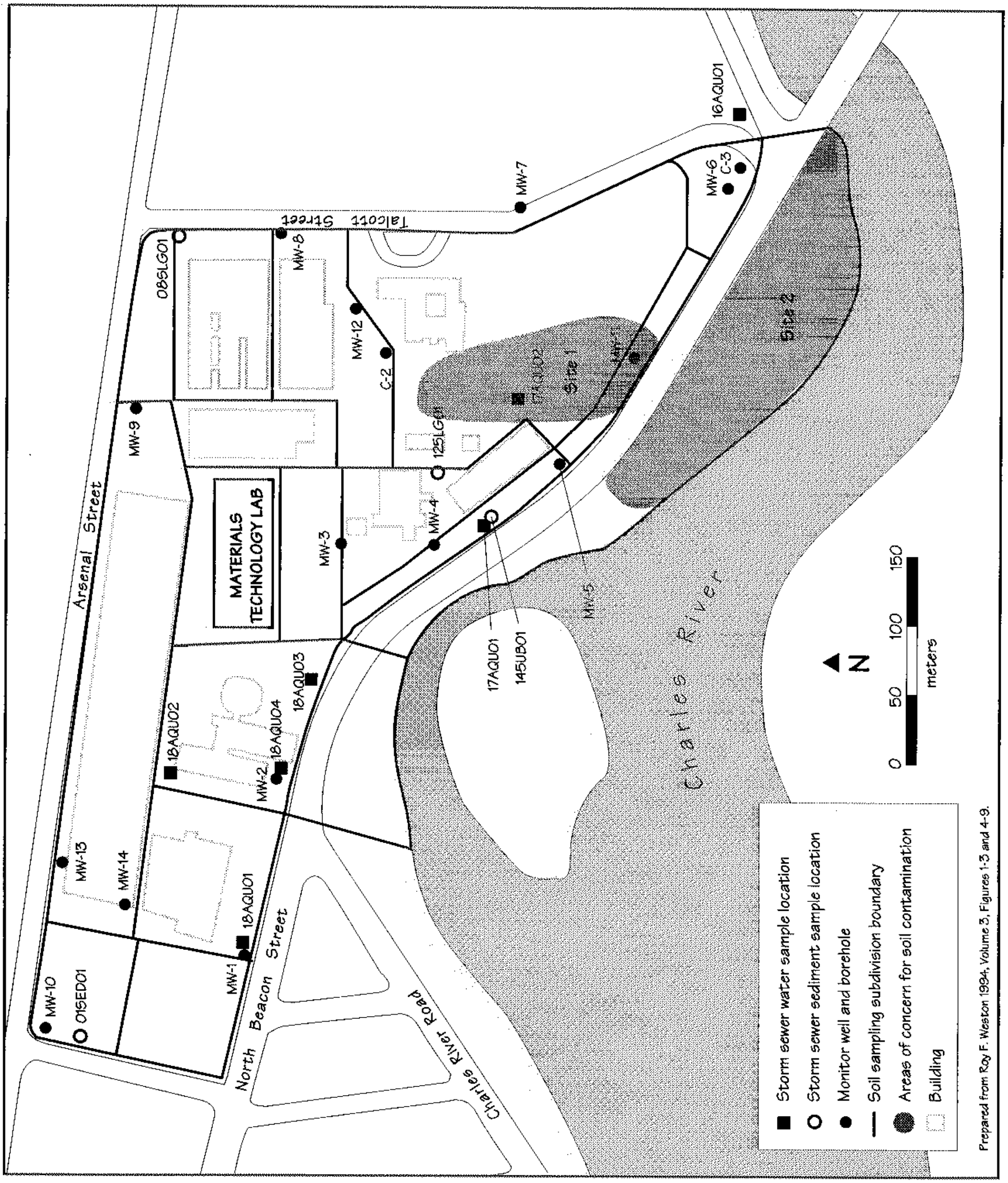


Figure 2. Detail of Materials Technology Lab site.

disposed are unknown (Halliburton NUS Environmental Corporation, 1993). Congress recommended closing the facility in October 1988. Closure procedures (i.e, RI/FS and remedial actions) continue at this time.

Surface water runoff, direct discharge, and groundwater migration are the potential pathways of contaminant transport from the site to NOAA trust resources and associated habitats. Approximately 75 percent of the site is covered with impervious surfaces, and the majority of surface water runoff is directed to an extensive storm sewer system. This on-site storm sewer system discharges directly to the Charles River through several outfalls. Groundwater beneath the site flows generally south and southeast towards the Charles River. Much of the site is overlain by over 3 m of sand and gravel fill, with glacial till deposits and bedrock siltston beneath. The glacial deposits range from 15 m thick on the western boundary to 45 m thick to the east. The current MTL property lies outside the 500-year flood zone, exception for a narrow strip of land along the riverbank (Roy F. Weston, Inc. 1994).

NOAA Trust Habitats and Species

Surface water and associated bottom substrates of the Charles River are habitats of primary concern to NOAA. NOAA trust resources near the site include four anadromous species: blueback herring, rainbow smelt, alewife, and American shad; and the catadromous American eel, which is found throughout the Charles River (Table 1). The surface water near the site is fresh water; the Charles River Dam and Locks 11.5 km downstream, in the lower Charles River basin, restrict the upstream flow of saline water from Boston Harbor. The Watertown Dam, about 2.5 km upstream from the site, is equipped with a functional fish ladder. Immediately below this dam,

Table 1. Major NOAA trust species that use surface water of the Charles River near the Materials Technology Lab site.

Species		Habitat			Fisheries	
Common Name	Scientific Name	Spawning	Nursery	Adult Forage	Comm.	Recr.
ANADROMOUS SPECIES						
Blueback herring	*Alosa aestivalis*	♦	♦	♦		♦
Alewife	*Alosa pseudoharengus*		♦	♦		
American shad	*Alosa sapidissima*		♦	♦		
Rainbow smelt	*Osmerus mordax*	♦	♦	♦		
CATADROMOUS SPECIES						
American eel	*Anguilla rostrata*		♦	♦		

increased water velocity and a bottom substrate of cobbles and larger rocks form a riffle habitat. The water flow decreases approximately 200 m below the dam, creating a slow-moving, meandering river habitat (Chase personal communication 1994). The Charles River receives runoff from combined sewer overflows and is considered eutrophic. Dissolved oxygen concentrations in the river are low, but remain above 5 mg/l. The river near the site is designated Class B (fishable and swimmable; Life Systems, Inc. 1993; Tisa personal communication 1994).

The blueback herring run on the Charles River is considered one of the largest in Massachusetts; densities of this anadromous species are highest near the site. Both blueback herring and rainbow smelt use the riffle habitat below the Watertown Dam for spawning. Blueback herring also spawn upstream from the Watertown Dam. Limited numbers of rainbow smelt migrate above the dam (Brady personal communication 1994).

Alewife and American shad are found in low numbers in the Charles River. Since the late 1970s the State of Massachusetts has conducted a stocking program to restore American shad in the Charles River. However, only a few returns have been documented above the Watertown Dam, and the program is being re-evaluated to determine the most effective stocking methods (e.g., stocking gravid adults versus juveniles). American shad spawn in slower-moving water upstream from the Watertown Dam, and possibly in the lower Charles River basin above the locks (Brady personal communication 1994).

There is a small recreational fishery for blueback herring, which are caught primarily for bait. The State allows herring to be caught only with a small, hand-held dip net and limits the catch to four days per week to protect the resource. However, it has proven difficult for the State to enforce these restrictions (Brady personal communication 1994). Sportfishing for rainbow smelt is prohibited during the smelt spawning season, from March 15 to June 15. The population of American shad is too small to support a recreational fishery, although some fish are caught incidentally. One of the goals of the American shad restoration program is to develop a sport fishery for shad in the Charles River (Brady personal communication 1994).

Site-Related Contamination

Data collected during the 1992 Phase 2 remedial investigation indicate that soils, groundwater, surface water, and sediments at the MTL facility contain elevated concentrations of site-related contaminants (Roy F. Weston, Inc. 1994). The primary contaminants of concern are trace elements, PAHs, and pesticides. Maximum concentrations of inorganic and organic contaminants are summarized in Tables 2 and 3, along with applicable screening guidelines. Maximum concentrations of radiological compounds detected are presented in Table 4.

Soil sampling was completed in November 1992. A total of 176 surface soil and boring samples were collected for laboratory analysis and used to evaluate the nature and extent of soil contamination at the MTL facility. There are two primary pathways by which soil contamination can migrate to other media: erosion and runoff to storm sewers with discharge to the Charles River, and leaching of contaminants to groundwater. Two portions of the MTL site have been identified as areas with contaminated soils (Halliburton NUS Environmental Corporation 1993). These areas, designated as Sites 1 and 2, are situated in the southeastern part of the MTL site near the Charles River (Figure 2). Soils from both sites contain trace elements at concentrations exceeding average U.S. soil concentrations (Table 3). Pesticides and PAHs were detected at both sites, but screening guidelines are not available for organic compounds in soils.

Groundwater samples were collected from 26 on-site wells and five off-site wells in December 1991 to ascertain the extent of groundwater contamination. Concentrations of cadmium and lead exceeded their respective chronic freshwater AWQC by more than a factor of ten. In addition, the pesticides DDT, heptachlor, and dieldrin were present at concentrations exceeding their chronic freshwater AWQCs, as shown in Table 2 (Roy F. Weston, Inc. 1994).

Table 2. Maximum concentrations (µg/l) in water samples collected for the Phase 2 Remedial Investigation Report, Army Materials Technology Laboratory.

Analyte	Groundwater	Stormwater	Charles River downstream from site	Charles River upstream from site	AWQC[1]
TRACE ELEMENTS					
Cadmium	32	NT	4.8	0.18	1.1+
Chromium	60	NT	19	2.5	11*
Copper	48	580	ND	20	12+
Lead	54	74	4.4	9.5	3.2+
Zinc	97	500	44	49	86
PESTICIDES					
DDT	0.28	ND	ND	ND	0.001
Heptachlor	0.19	ND	ND	ND	0.0038
Lindane	0.17	ND	0.0037	0.0034	0.08
Dieldrin	0.031	ND	ND	ND	0.0019

1: Ambient water quality criteria for the protection of aquatic organisms. The lower value of the marine or freshwater chronic criteria is presented (EPA 1993) because waste sites are located near both marine and freshwater environments.
NT: Not tested
ND: Not detected
+: Value dependent on hardness (100 mg/l $CaCO_3$ used)
*: Value is for Cr^{+6}

Table 3. Maximum concentrations (mg/kg) in soil and sediment samples collected for the Phase 2 Remedial Investigation Report, Army Materials Technology Laboratory.

	Soil		Sediment			
Analyte	Soil	Average U.S. soil[1]	Stormdrain	Charles River downstream from site	Charles River upstream from site	ERL[2]
TRACE ELEMENTS						
Cadmium	13	0.06	6.2	25	13	1.2
Chromium	380	100	450	160	120	81
Copper	1400	30	15,000	1000	280	34
Lead	7200	10	560	1,900	780	47
Mercury	4.50	0.03	15	2.2	1.7	0.15
Nickel	1800	40	230	55	39	21
Zinc	1400	50	1000	890	690	150
ORGANIC COMPOUNDS						
Acenaphthene	75	NA	NT	4.7	0.454	0.016
Anthracene	120	NA	NT	10.1	NT	0.085
Benzo(a)anthracene	340	NA	16.3	23	10	0.26
Benzo(a)pyrene	120	NA	NT	29	17	0.430
Chrysene	280	NA	18	22	3.0	0.38
Dibenz(a,h)anthracene	47	NA	NT	4.3	NT	0.063
Fluoranthene	120	NA	26	31	13	0.60
Fluorene	170	NA	1.3	5.6	0.89	0.035
2-Methylnaphthalene	72	NA	NT	1.1	0.53	0.065
Phenanthrene	240	NA	22.5	80	8.9	0.24
Pyrene	120	NA	32	58	22	0.67
PESTICIDES						
DDD	3.5	NA	NT	0.62	0.25	0.002
DDE	6.3	NA	NT	0.38	0.18	0.002
DDT	9.6	NA	NT	0.7	0.31	0.001
Heptachlor	0.032	NA	NT	ND	NT	NA
Lindane	0.26	NA	NT	0.001	NT	NA
Dieldrin	4.0	NA	NT	0.48	1.9	0.00002
Endrin	0.34	NA	NT	0.05	NT	0.00002

1 Lindsay (1979).
2: Effects range low; the concentration representing the lowest 10-percentile value for the data in which effects were observed or predicted in studies compiled by Long and MacDonald (1992).
NT: Not tested
ND: Not detected
NA: Not available

Fourteen river water samples were collected; nine samples were collected downstream of the site and five samples were collected upstream to provide background data for comparison. Five more water samples were collected from on-site storm sewers that drain directly to the Charles River (Roy F. Weston, Inc. 1994). Cadmium, chromium, and lead were detected at concentrations exceeding chronic freshwater AWQC (Table 2) in the Charles River below the site.

Table 4. Maximum concentrations (pCi/g) for radioactive analytes detected in samples from Army Materials Technology Laboratory.

	Water			Soil	Sediment	
Radioactive Analyte	Charles River	Storm Sewer	Groundwater	On-site	Charles River	Storm Sewer
Alpha gross	2	3	24	38	35	110
Beta gross	10	5	110	39	38	120
Uranium-234	0.9	0.2	1.3	2.4	1.4	7.9
Uranium-235	NT	NT	0.1	0.3	0.2	0.9
Uranium-238	0.5	0.1	1.2	3.4	1.5	55

NT: Not tested

Copper and lead in river water collected upstream of the site exceeded chronic freshwater AWQC (Table 2). Copper, lead, and zinc concentrations in stormwater draining the site also exceeded chronic freshwater AWQC (Table 2).

Sediment samples were collected from the Charles River at 13 locations downstream from the MTL site, five locations upstream, and from four storm sewers located on the site (Roy F. Weston, Inc. 1994). Trace elements, PAHs, and pesticides were found in sediments at concentrations that pose a threat to NOAA trust resources. Sediments sampled from the Charles River (downstream and upstream) and stormdrains draining the site exceeded ERL guidelines for seven trace elements: cadmium, chromium, copper, lead, mercury, nickel, and zinc. Several pesticides and PAH compounds were also detected in sediments at concentrations exceeding screening guidelines (Table 3).

Radiological compounds were detected in surface water, groundwater, soil, and sediment samples (Table 4). Although detected radionuclides at the site exceeded upstream concentrations in both surface water and sediment, the consultant to the U.S. Army advised EPA that remediation of radiological contamination in the environment at MTL was not needed (Roy F. Weston, Inc. 1994). No screening guidelines are available to assess the potential radiological threat to NOAA trust resources. All buildings known or suspected to be contaminated were decontaminated in May 1993 (Roy F. Weston, Inc. 1994).

Summary

Trace element and pesticide concentrations detected in the Army MTL site's groundwater, surface water, soil, and sediments exceeded screening guidelines. PAHs were also detected in soils and sediments. PAH concentrations in sediment exceeded ERL screening guidelines. NOAA trust resources near the site include four anadromous species: blueback herring, rainbow smelt, alewife, and American shad; and the catadromous American eel. The blueback herring run is one of the largest in Massachusetts, with densities highest near the site. Site-related contamination could affect these NOAA trust resources near the site as well as habitat in the Charles River and Boston Harbor downstream from the site.

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3

UGI Columbia Gas Plant

Columbia, Pennsylvania
CERCLIS #PAD980539126

Site Exposure Potential

The UGI Columbia Gas Plant covers 0.65 hectares in Columbia, Pennsylvania (Figure 1). The Susquehanna River flows about 120 m southeast of the site, discharging into Chesapeake Bay 72 km downstream.

Columbia Gas manufactured gas at the site from 1851 to 1949. In 1932, Columbia Gas became a subsidiary of Pennsylvania Power and Light (PP&L). In 1949, the property was transferred to Lancaster County Gas Company, which later merged with UGI Corporation. Gas manufacturing ceased at the site and the plant was later decommissioned. The land was privately purchased in 1976 and used as a boat dealership. PP&L bought the site in 1994.

Before 1910, the facility reportedly generated gas from wood. In 1910, the plant was rebuilt so that gas could be manufactured from coal. A hazard ranking conducted for EPA in 1993 concluded that the site consisted of three contaminant sources: the city holder, the relief holder, and contaminated soil (NUS 1993). Details on the gas manufacturing process at the plant, including the exact use of these holders (underground storage tanks of unknown construction) were incomplete in the documents reviewed for this report. Hazardous substances associated with the site's contaminant sources and

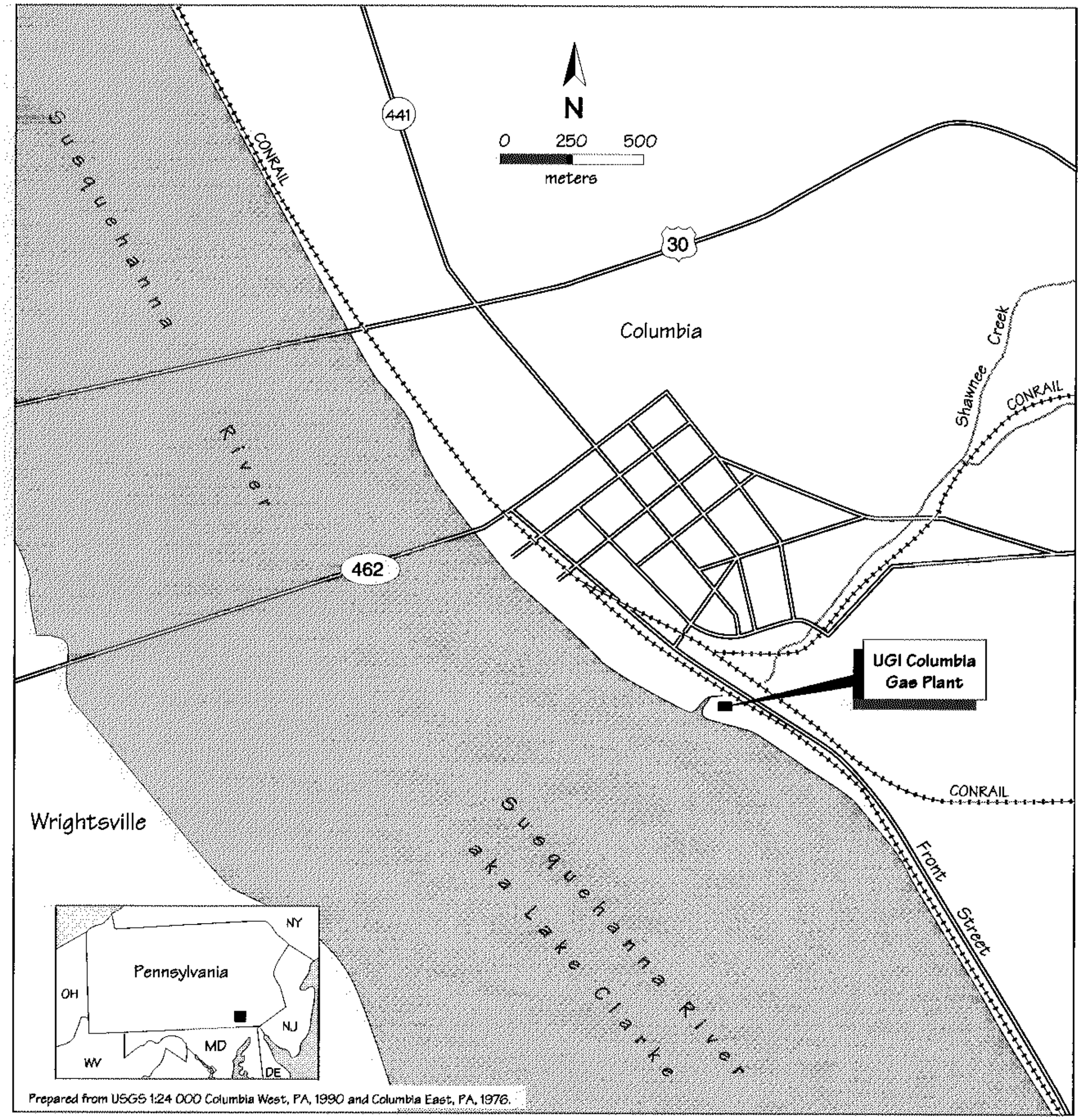

Figure 1. The UGI Columbia Gas Plant in Columbia, PA.

waste streams include PAHs, VOCs, SVOCs, trace elements, and cyanide. Liquid waste streams from the gas-manufacturing process were directed to a separator that separated the tar from water. The separator overflowed during heavy rains and discharged to an open ditch that led to the Susquehanna River. The exact location of this ditch was not displayed on maps available for the site (see Figure 2 for site map). Investigations completed in 1986 and 1987 found an area of tar-contaminated river sediment southwest and directly downstream of the site, but the area was covered with fill material when inspected in 1991 (NUS 1991). In 1947, an event described as a "structural failure of the relief holder" occurred, but no information was found on what, if any, contaminants were released. When the property was regraded after 1979, tars within the relief holder were displaced and flowed onto the surrounding soil. The tars were then pushed into a railroad pedestrian tunnel bordering the site and a dike was built at the tunnel entrance to contain the tars. In 1987, a remedial action removed about 76 m^3 of tar-contaminated material from the tunnel, built a concrete floor in the tunnel, and capped the city and relief holders with concrete slabs (NUS 1993).

Groundwater discharge and surface water runoff are the potential pathways of contaminant transport from the site to NOAA trust resources and associated habitats. Preliminary investigations at the site indicated that the depth to the limestone bedrock at the site varies from about 2 to 8 m. Alluvial deposits at and near the site consist of silty clay overlying interbedded, coal-rich, laminated sands and coal-rich silty clays, and contain coarse sand or quartz pebble gravel in some locations. Surficial geology consists of a fill layer, alluvium, and limestone bedrock. The fill is a heterogeneous mixture of sand, ash, slag, cinders, brick, and wood chips. Where saturated, the bedrock and the overlying alluvium act as a single shallow aquifer beneath the site. Groundwater flows generally toward the Susquehanna River, although Shawnee Creek, which flows along the western boundary of the site, is also considered a discharge site for local groundwater. Bedrock fractures may provide a pathway for groundwater transport (NUS 1993).

The site drains overland southwest toward the Susquehanna River. The extent of drainage from the site to Shawnee Creek was not clear from information available. Preliminary investigations determined that the open ditch that received tar-separator overflow and discharged into the river was probably a major pathway for tar-contaminated substances from the site. The open ditch has since been covered by fill under the river floodplain. There is no clear drainage pathway to the river because of Front Street and railroad tracks between the site and the river. Three pipes were found in the river bank southwest of the site: one extended from the direction of the site and two extended from a municipal sewage plant directly south of the site. No other information was found on these pipes (Atlantic Environmental Services 1987).

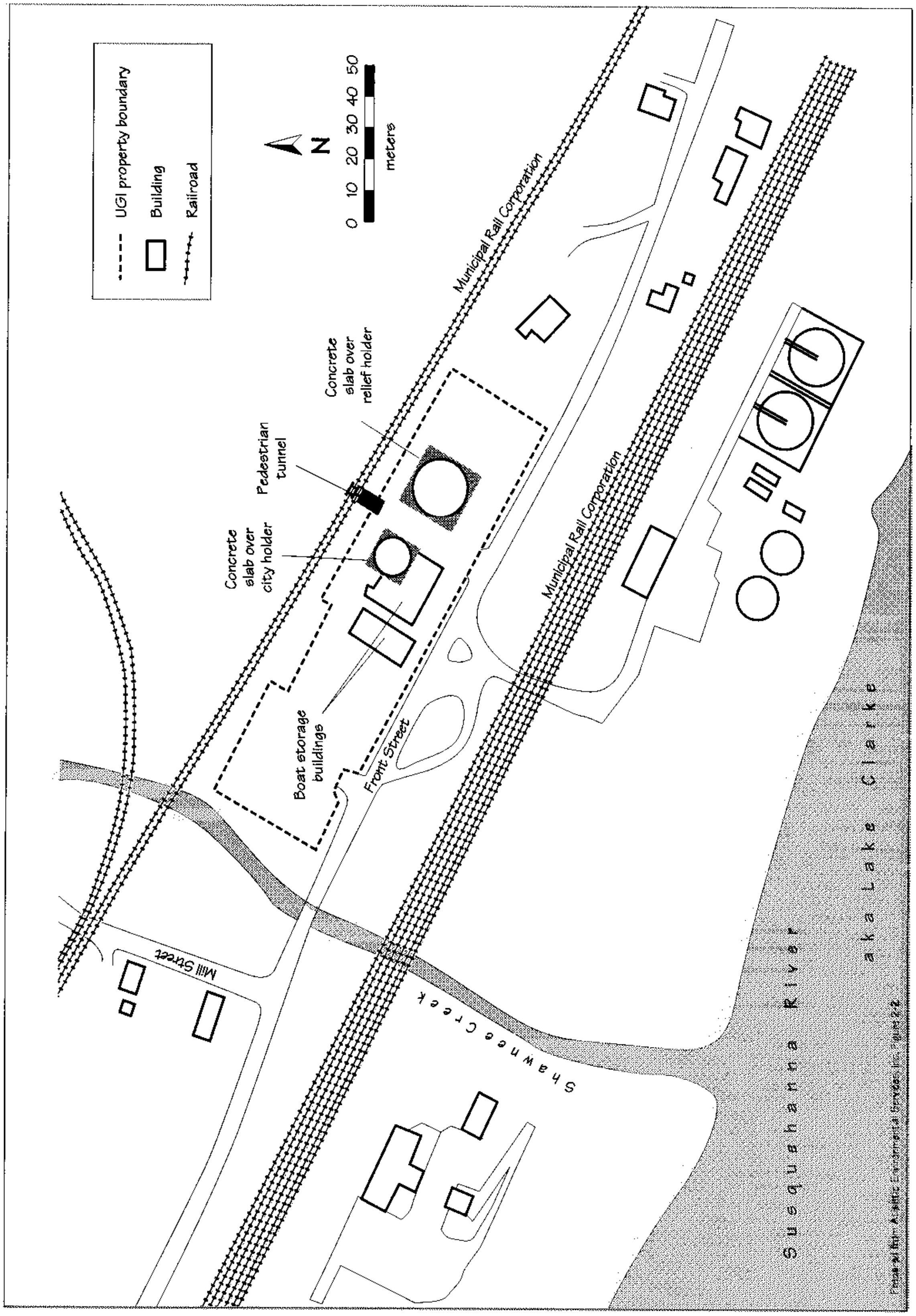

Figure 2. Detail of UGI Columbia Gas Plant.

NOAA Trust Habitat and Species

Habitats of potential concern to NOAA are surface water and associated bottom substrates of the Susquehanna River near the UGI Columbia Gas Plant site. The Susquehanna River basin encompasses 46 percent of Pennsylvania; a drainage area of 55,000 km^2 (USGS 1985). In general, development in the floodplain has resulted in extensive flood control modifications on the Susquehanna River, including the creation of a network of canals, levees, and holding ponds to contain spring floods. These actions have altered the natural river course and riverine habitats (Noland personal communication 1990; St. Pierre personal communication 1994). Moreover, hydroelectric dams have greatly reduced the habitat available for NOAA trust resources. Three major hydroelectric facilities are downstream from the site: the Safe Harbor Dam is 18 km downstream, the Holtwood Dam is 30 km, and the Conowingo Dam is 55 km. The Conowingo Dam is the only dam equipped with fish passage facilities. The Holtwood Dam thus limits natural upstream migration of anadromous fish (St. Pierre personal communication 1994) to approximately 42 river km upstream from the mouth of the Susquehanna River.

American shad and American eel are the only two NOAA trust resources recently identified above the Holtwood Dam in the Susquehanna River near the site (Jackson personal communication 1993; St. Pierre personal communication 1994). Stocking efforts and trap/transport/release operations maintain shad in the upper river. Adult American shad are trapped at the Conowingo Dam fish lift and released farther upstream in Columbia and Middleton, Pennsylvania. Hatchery-raised American shad fry and fingerlings are stocked in the Juanita River, a tributary of the Susquehanna River, approximately 115 km upstream from the site at Thompsontown, Pennsylvania. These stocking efforts are designed to propagate the American shad populations in the central Susquehanna River watershed (St. Pierre personal communication 1994). Habitats near the site are likely to provide spawning habitat to adult American shad, while juvenile shad use surface water near the UGI site for rearing (Jackson personal communication 1993).

Although there are American eel throughout the river basin, there has been a marked reduction in the population within the last ten years. Naturally migrating juvenile eel (elvers) returning from the sea cannot pass the three dams downstream of the site. The existing, very limited American eel population is a remnant stock previously released by the Pennsylvania Fish Commission. Stocking of eel was discontinued in the 1970s. If abundant numbers of elvers reappear at the Conowingo Dam fish lift, they will be permitted to use the fish passage facilities or will be trapped and transported upstream (St. Pierre personal communication 1994).

A restoration program has been instituted for American shad, blueback herring, alewife, and American eel. The scope of this program is to (1) encourage the utilities to implement facility improvements that will enable migration, and (2) sustain hatchery and lift-, trap-, and transport-stocking of juveniles and adults until the fish populations naturally rejuvenate. A permanent passageway at the Conowingo Dam was completed in 1991 and successfully passed American shad in 1991 (27,227 individuals), 1992 (25,721), 1993 (13,546), and 1994 (30,000+ [still counting]; St. Pierre personal communication 1994).

The remaining utilities on the river will begin similar fish run-restoration programs for their facilities. It is expected that both these projects will be completed by the year 2000, ultimately restoring multi-species migration and greatly reducing out-migration mortality attributed to hydroelectric turbines. Authorities are optimistic that near-historic patterns of migration and spawning populations of American shad, blueback herring, alewife, and American eel can be restored in the upcoming decades, after fish passage facilities are installed on the Susquehanna River (St. Pierre personal communication 1994).

Although there are no commercial or recreational fisheries for NOAA trust resources near the site, these fisheries are expected to reappear as stocks proliferate and habitats are restored (St. Pierre personal communication 1994).

Site-Related Contamination

The contaminants of primary concern to NOAA are PAHs and trace elements (Table 1). Previous investigations at the site have identified contaminants from the facility in groundwater and soil at the site, and in sediments in a portion of the Susquehanna River. Numerous PAHs were detected in surface and subsurface soils at the site. No screening criteria or guidelines are available for these contaminants in soils. The trace elements arsenic, cadmium, copper, lead, mercury, nickel, and zinc were detected in surface soils at concentrations above average U.S. soil concentrations (TRC 1986).

The PAHs acenaphthene, naphthalene, and phenanthrene, as well as the aromatic hydrocarbons ethylbenzene and toluene, were each detected in groundwater at the site at concentrations that exceeded the LOEL reported in the EPA AWQC development documents. Concentrations of benzene (310 mg/l) and several PAHs were also detected, though there are no screening guidelines or criteria for these contaminants. Of the trace elements detected in groundwater, only lead was detected at concentrations exceeding the freshwater AWQC by more than ten times (NUS 1991). Although mercury was below the detection limit of 0.2 μg/l, this detection limit is more than ten times the chronic AWQC of 0.012 μg/l.

Table 1. Maximum concentrations of selected analytes from investigations at the UGI Columbia Gas Plant site.

	Soil (mg/kg)			Water (µg/l)			Sediment (mg/kg)		
Analytes	Sub-surface	Surface	U.S. Ave.[a]	Surface Water	Ground-water	Chronic AWQC[b]	River	ERL[e]	ERM[e]
TRACE ELEMENTS									
Arsenic	ND	13	5.0	11	16	NA	2.7	8.2	70
Cadmium	ND	5	0.06	<4	4.5	1.1+	ND	1.2	9.6
Copper	NA	280	30	16	56	12.0+	83	34	270
Lead	ND	390	10	23	110	3.2+	45	46.7	218
Mercury	NA	0.65	0.03	<0.2	<0.2	0.012	0.025	0.15	0.71
Nickel	NA	72	40	16	53	160+	21	20.9	51.6
Zinc	NA	1080	50	43	230	110+	200	150	410
PAHs									
Acenaphthene	190	3.8	NA	ND	800	520[c]	36	0.016	0.5
Anthracene	60	NA	NA	ND	510	NA	29	0.853	1.1
Fluorene	190	NA	NA	ND	630	NA	28	0.019	0.54
Naphthalene	1320	13	NA	ND	25,000	620[c]	12	0.16	2.1
Phenanthrene	1500	3.4	NA	ND	4,100	6.3[d]	89	0.24	1.5
Benzo(a)pyrene	350	62	NA	ND	210	NA	8.3	0.43	1.6
Chrysene	3.8	5.5	NA	ND	180	NA	13	0.384	2.8
Fluoranthene	ND	6.6	NA	ND	480	NA	27	0.6	5.1
Pyrene	1700	12	NA	ND	850	NA	55	0.665	2.6
Benzo(a)anthracene	2.7	4.6	NA	ND	270	NA	13	0.261	1.6
Total PAHs	2,500	66	NA	ND	14,000	NA	310	4.022	45
VOCs									
Benzene	0.02	ND	NA	20	310	NA	ND	NA	NA
Ethyl benzene	0.012	ND	NA	6	60	32[c]	ND	NA	NA
Toluene	0.022	ND	NA	4	190	18[c]	ND	NA	NA

a: Lindsay (1979).
b: Ambient water quality criteria for the protection of aquatic organisms. Freshwater chronic criteria presented (U.S. EPA 1993).
c: Insufficient data to develop criteria. Value presented is the freshwater chronic Lowest Observed Effect Level (U.S. EPA 1993).
d: Proposed criterion (U.S. EPA 1993).
e: Long and MacDonald (1992).
+: Value is dependent on hardness (100 mg/l $CaCO_3$ used).
ND: Not detected.
NA: Not analyzed or not available.
<: Not detected at detection limit listed.

A 1986 investigation delineated a zone of tar-contaminated sediment that extended a minimum of 3.3 m into the river along a 20-m stretch of the riverbank (TRC Environmental Consultants 1986). Another investigation of the river sediments in 1987 determined that tar impacts in the river sediment (approximately 612 m^3) extended approximately 33 m along the riverbank and about 16 m into the river (Atlantic Environmental Services 1987). The 1987 report concluded that tar was actively migrating through the floodplain sediments into the river sediments and that the source was probably the open ditch that received the tar separator overflow. Sediment sampling for the 1986 investigation reported ten PAHs with concentrations that exceeded ERM concentrations, all of which came from the same sample station located directly downgradient of the site. The 1991 investigation did not find the visibly tar-contaminated sediments reported in the 1986 and 1987 reports, but rather found the area to be covered with fill material. Sample results from the fill area had lower concentrations of contaminants, none of which exceeded ERM concentrations (naphthalene, 0.630 mg/kg; phenanthrene, 1.30 mg/kg; fluoranthene, 1.5 mg/kg; pyrene, 1.5 mg/kg; and benzo(a)pyrene, 0.620 mg/kg). No trace elements were detected in sediments at concentrations that exceeded ERM screening guidelines, but copper and zinc in sediment exceeded ERL values (NUS 1991).

None of the contaminants identified in surface water from the Susquehanna River was detected at concentrations above chronic freshwater AWQC.

Work plans have been developed to further characterize the extent of site-related contamination in river sediments and contamination of soil, surface water, and groundwater at the site (Atlantic Environmental Services 1993, 1994).

Summary

PAHs and trace elements have been detected at elevated concentrations in on-site soil and groundwater at the site. PAHs have also been detected at elevated concentrations in Susquehanna River sediments. These habitats currently support populations of the NOAA trust resources American shad and American eel. Sampling done in the mid-1980s documented contaminant migration from the site to the river: tar-contaminated river sediments extended about 33 m along the riverbank and about 16 m into the river. Ten PAHs were detected at levels above ERM concentrations. The contaminated area has since been covered with fill material. Sampling has found reduced concentrations of contaminants in the surface sediment, but there is no record that contaminants have been removed from the sediment. Further sampling should more accurately determine the vertical and lateral extent of the sediment contamination. The planned restoration of the Susquehanna River by 2000 could allow more NOAA trust resources to migrate to this section of the river, potentially exposing these fish to toxic concentrations of contaminants.

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4

Chemfax, Inc.

Gulfport, Mississippi
CERCLIS #MSD008154486

Site Exposure Potential

The Chemfax, Inc. site, established in 1955, occupies approximately four hectares in a heavily industrialized area of Gulfport, Mississippi (Figure 1). About 200 m south of Bernard Bayou, the facility produces synthetic hydrocarbon resins and waxes from petroleum. The primary operation is a paraffin-blending process in which different grades of paraffin wax are melted together, blended, and subsequently cooled with non-contact cooling water.

On-site features include a processing building, warehouse; an unspecified number of deteriorating storage tanks containing recovered solvents, diesel fuel, and unspecified raw materials; a cooling pond; two holding ponds; two drainage ditches; and a former lagoon (Figure 2). Some site-derived wastes are stored at the site and include polycyclopentadiene, polyhexadiene, polystyrene, and polyvinyl toluene. A glue production facility, owned and operated by Alpine Masonite, Inc., is just to the west (NUS 1991).

Contaminants can potentially migrate off the site to NOAA trust resources and habitats via surface water runoff and groundwater. The site maintains a two-percent slope over most of the property; two drainage ditch systems direct surface water runoff from the site. One ditch system at

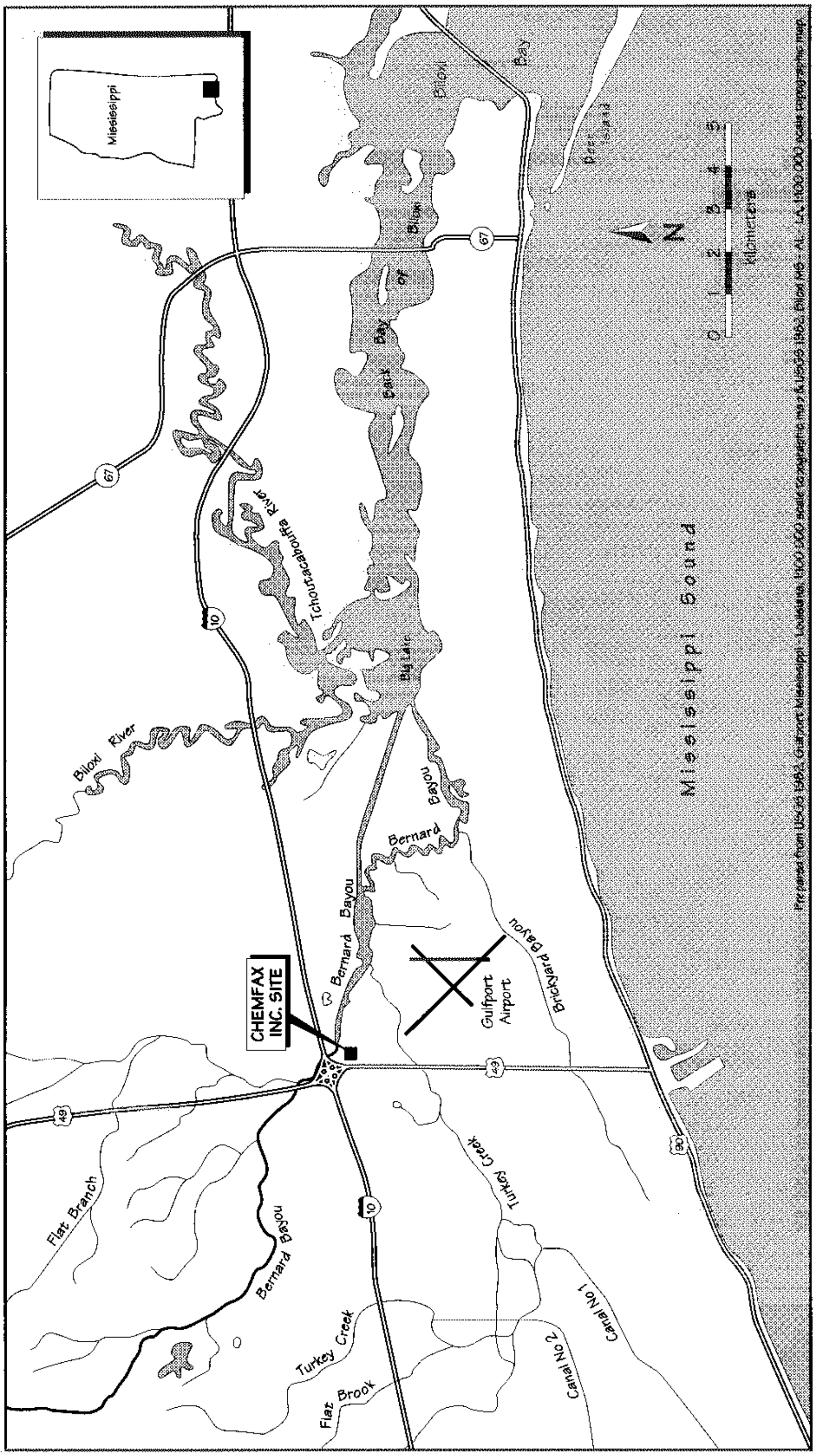

Figure 1. The Chemfax, Inc. site in Gulfport, Mississippi.

the south end of the site begins at the cooling pond and runs east, paralleling railway tracks (Figure 2). The ditch is diverted under Three Rivers Road via a culvert and then directed north parallel to the road and into Bernard Bayou about 475 m downstream from the ditch's origin. A second drainage ditch system leads from the two central site areas. The ditch is diverted under Three Rivers Road via a culvert where it joins the flow of the ditch from the southern portion of the site and discharges into Bernard Bayou approximately 350 m downstream from its origin (NUS 1991).

Chemfax, Inc. has held a NPDES permit since 1974 authorizing it to discharge non-contact waste water, steam condensate, and stormwater runoff from a retention pond at the facility into Bernard Bayou via the drainage ditch system (NUS 1991). Temperature, BOD, TSS, COD, and oil and grease levels are regulated in the discharge. When the NPDES permit was renewed in 1979, phenol was added to the list of substances regulated. Violations of phenol levels were documented in August and November 1980, and in April 1984 (U.S. EPA 1994).

Numerous aquifers have been described near the site. The upper aquifer, the Citronelle Formation, is composed of quartz sand, chert gravel and lenses, and layers of clay. The Citronelle Formation serves as the surficial aquifer in the Gulfport area. Water levels are generally encountered at less than 3 m below ground surface. The saturated thickness of the Citronelle aquifer ranges from 6 to 31 m. The Graham Ferry Formation and Miocene Aquifer System (30 m below ground surface and deeper) underlie the Citronelle Formation and contain one of the most highly productive aquifers in the Gulfport area. Contaminants have infiltrated shallow groundwater at the site, via leaking storage tanks and on-site spills, as well as from routine discharges to the holding and cooling ponds (NUS 1991).

NOAA Trust Habitats and Species

Habitats of primary concern to NOAA are surface water, associated bottom substrates, and intertidal emergent wetlands of Bernard Bayou, Big Lake, and the Back Bay of Biloxi. Of secondary concern are surface water and substrates of Biloxi Bay. Salinities in Bernard Bayou range from 0 to 3 ppt and fluctuate throughout the year depending on rainfall, saltwater intrusion, and urban runoff. Substrate composition of Bernard Bayou, Big Lake, and the Back Bay of Biloxi is predominantly mud (Buchanan personal communication 1993; Warren personal communication 1993). From the confluence of site-related ditches with Bernard Bayou, the bayou flows east-southeast for approximately 3.5 km. At that point, surface water diverted into a canal travels about 5 km east before entering Big Lake, while the remainder of the water continues east-southeast through Bernard Bayou for about 10 km before entering

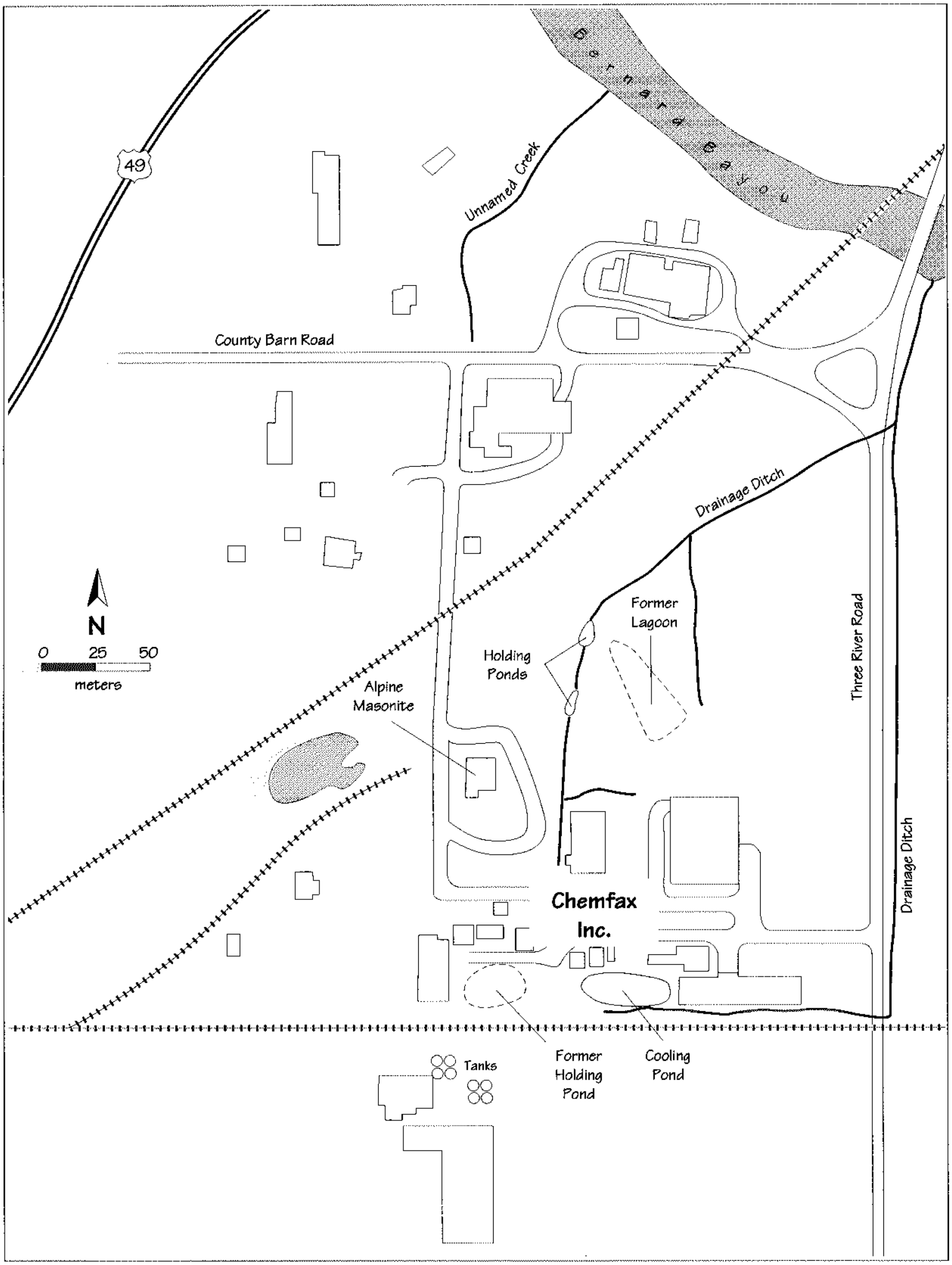

Figure 2. Detail of the Chemfax, Inc. site (NUS 1991).

Big Lake farther downstream. Big Lake surface water joins the Back Bay of Biloxi about 2.5 km farther east. Chemfax is about15 km upstream from Biloxi Bay and about 27 km upstream from the Mississippi Sound.

Bernard Bayou, Big Lake, and the Back Bay of Biloxi support diverse, abundant populations of NOAA trust resources that are likely to migrate close to the site and reside there for extended periods during sensitive life stages. Aquatic habitats, including wetlands associated with surface water near the site, provide significant nursery habitat for numerous species (Table 1; Nelson 1992; Buchanan personal communication 1993; Warren personal communication 1993). Dominant wetland vegetation in the area consists mostly of sedges (*Carex* spp., *Cyperus* spp.), black needlerush (*Juncus roemerianus*), sawgrass (*Cladium jamaicense*), tearthumb (*Polygonum* spp.), and arrowhead (*Sagittaria* spp.; Buchanan personal communication 1993).

The most abundant NOAA trust species in Bernard Bayou include brown and white shrimp, blue crab, Atlantic croaker, bay anchovy, spot, spotted seatrout, red drum, and white mullet (Nelson 1992; Warren personal communication 1992). Blue crab mate in Bernard Bayou and its surrounding wetlands. The catadromous American eel is seen throughout the area. Spot and Atlantic croaker are commonly present in the area from early spring to early winter and occur in greatest numbers during the spring and summer (Warren personal communication 1992).

Commercial fisheries near the site are limited to white and brown shrimp, and blue crab, which generally occur in Biloxi Bay. Popular sport fisheries in the area include Atlantic croaker, blue crab, red drum, southern flounder, spot, and spotted sea trout. There are no restrictions on these fisheries other than general regulations on take limit and minimum sizes (Warren personal communication 1992).

Site-Related Contamination

As part of a 1990 site investigation, 15 sediment samples, 14 surficial soil samples, 23 subsurface soil samples, and three surface water samples were collected. Source areas identified at the facility included a cooling pond, a former lagoon area, a former holding pond, the three drainage ditches, and eight storage tanks. All sediment, soil, and groundwater samples were analyzed under the Contract Laboratory Program and were analyzed for all parameters listed in the TCL. Only a few selected inorganic substances, two VOCs, and one unidentified compound were detected and quantified in surface water samples (NUS 1991). Detection limits were not available.

The primary contaminants of concern to NOAA are trace elements and PAHs. Other contaminants include PCBs, pesticides, and additional VOCs and SVOCs. These latter contaminants were limited in distribution and were usually not found at concentrations exceeding screening

Table 1. Important fish and invertebrate species, and habitat use for Bernard Bayou and the Back Bay of Biloxi (Nelson 1992; Warren personal communication 1992; Buchanan personal communication 1993).

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS/CATADROMOUS SPECIES						
Alabama shad	*Alosa alabamae*		◆			
American eel	*Anguilla rostrata*		◆	◆		
ESTUARINE SPECIES						
Bay anchovy	*Anchoa mitchilli*		◆			
Sheepshead	*Archosargus probatocephalus*		◆			
Hardhead catfish	*Arius felis*		◆			
Silver perch	*Bairdiella chrysoura*		◆			
Gulf menhaden	*Brevoortia patronus*		◆			
Sand seatrout	*Cynoscion arenarius*		◆			
Spotted seatrout	*Cynoscion nebulosus*		◆			◆
Sheepshead minnow	*Cyprinodon variegatus*		◆			
Gizzard shad	*Dorosoma cepedianum*		◆			
Gulf killifish	*Fundulus grandis*		◆	◆		
Longnose killifish	*Fundulus similis*		◆	◆		
Pinfish	*Lagodon rhomboides*		◆			
Spot	*Leiostomus xanthurus*		◆			◆
Atlantic silversides	*Menidia spp.*		◆			
Atlantic croaker	*Micropogonias undulatus*		◆			◆
Striped mullet	*Mugil cephalus*		◆			
White mullet	*Mugil crema*		◆	◆		◆
Southern flounder	*Paralichthys lethostigma*		◆			◆
Black drum	*Pogonias cromis*		◆			
Red drum	*Sciaenops ocellatus*		◆			◆
Hogchoker	*Trinectes maculatus*		◆	◆		
INVERTEBRATE SPECIES						
Blue crab	*Callinectes sapidus*	◆	◆	◆	◆	◆
Grass shrimp	*Palaemonetes pugio*	◆	◆	◆		
Brown shrimp	*Penaeus aztecus*		◆	◆	◆	
White shrimp	*Penaeus setiferus*		◆	◆	◆	
Common rangia	*Rangia cuneata*	◆	◆	◆		

guidelines in the sampled media. The maximum concentrations of contaminants detected in media collected from the site are presented in Table 2.

Trace elements were sporadically detected at elevated concentrations in soil, sediment, and groundwater. Concentrations of arsenic, lead, mercury, and zinc were detected at concentrations exceeding their respective average U.S. soil concentrations (Lindsay 1979). Chromium, copper, lead, and mercury were detected in groundwater samples at concentrations above their respective freshwater chronic AWQC by

Table 2. Maximum concentrations of contaminants of concern at Chemfax, Inc.

Contaminants	Sediment (mg/kg)					Soils (mg/kg)		Water (µg/l)		
	Tank Area	Cooling Pond	Drainage Ditch	Bernard Bayou [a]	ERL [b]	On-site Soils	Average US [c]	Ground-water	Surf. Water	AWQC [d]
TRACE ELEMENTS										
Arsenic	ND	ND	6.7	ND	8.2	5.9	5	39	NT	190
Cadmium	NT	NT	NT	NT	1.2	NT	0.06	NT	NT	1.1+
Chromium	35	ND	23	ND	81	21	100	210	NT	11
Copper	19	12	19	3.8	34	18	30	250	ND	12+
Lead	210	31	21	20	46.7	53	10	190	6	3.2+
Mercury	ND	0.43	ND	0.54	0.15	1.3	0.03	0.38	NT	0.012
Nickel	31	3.7	2.5	ND	20.9	7.6	40	210	NT	160+
Silver	ND	ND	ND	6.3	1.0	ND	0.05	NT	NT	0.12
Zinc	450	160	86	27	150	230	50	610	NT	110+
PAHs										
Acenaphthene[e]	ND	ND	30	ND	0.016	24	NA	190	NT	520*
Fluorene	0.4	ND	33	ND	0.019	38	NA	20	NT	NA
Phenanthrene	1.4	ND	97	0.1	0.240	180	NA	410	NT	6.3**
Anthracene	0.7	ND	18	0.05	0.0853	40	NA	38	NT	NA
Fluoranthene	0.2	ND	18	0.3	0.600	35	NA	11	NT	NA
Pyrene	1.4	ND	22	0.3	0.665	120	NA	120	NT	NA
Benzo(a)anthracene	ND	ND	4.5	0.1	0.261	55	NA	4	NT	NA
Chrysene	0.8	ND	6.4	0.2	0.384	79	NA	22	NT	NA
Benzofluoranthenes	ND	ND	1.6	0.2	NA	18	NA	NT	NT	NA
Benzo(a)pyrene	ND	ND	2.0	ND	0.430	25	NA	NT	NT	NA
Indeno(1,2,3-c,d)pyrene	ND	ND	0.1	ND	NA	0.06	NA	NT	NT	NA
Benzo(g,h,i)perylene	ND	ND	0.9	ND	NA	0.09	NA	NT	NT	NA
Naphthalene[f]	10	200	200	0.5	0.160	380	NA	10,000	NT	NA
2-Methylnaphthalene	5.8	27	120	0.07	0.070	170	NA	1,800	NT	NA
Total PAHs	17.2	230	25.8	1.8	4.0	NR	NA	NR	NT	NA

a: Actual sampling location was situated in the area where the Chemfax drainage ditch discharges to Bernard Bayou.
b: Effects range-low ; the concentration representing the lowest 10-percentile value for the data in which effects were observed or predicted in studies compiled by Long and Morgan (1991; for the organic compounds) and Long and MacDonald (1992; for the inorganic substances).
c: Lindsay (1979).
d: Freshwater chronic.
e: Region 4 ETAG recommends using 52 ppb for surface water screening.
f: Region 4 ETAG recommends using 62 ppb for surface water screening.
NA: Screening guidelines not available.
ND: Not detected; detection limit not available.
NT: Not tested.
NR: Not reported
+ Hardness-dependent criteria; 100 mg/l $CaCO_3$ used.
* Insufficient Data to Develop Criteria. Value Presented is the L.O.E.L. (Lowest Observed Effect Level; USEPA 1993).
** Proposed Criterion.

factors greater than 10. Lead and zinc (collected from the tank area), and mercury and silver (collected from the drainage outlet of the on-site drainage ditch, next to Bernard Bayou) were the only trace elements detected in sediments at concentrations exceeding their respective ERL (Long and MacDonald 1992) screening guidelines (NUS 1991).

Phenanthrene, pyrene, chrysene, naphthalene, and 2-methylnaphthalene were the dominant PAHs detected in on-site soil samples. Sediment samples collected from on-site drainage ditches also contained elevated concentrations of numerous PAHs that exceeded their respective ERL screening guidelines. PAHs were detected less frequently at elevated concentrations in groundwater samples. Only chrysene, detected at a maximum concentration of 410 µg/l in groundwater, exceeded AWQC by more than a factor of 10. Neither pesticides nor PCBs were detected in groundwater samples at concentrations exceeding screening guidelines (NUS 1991).

Lead (6 µg/l) was detected in one of the three surface water samples collected from the Chemfax drainage ditch next to Bernard Bayou at a concentration slightly exceeding its ambient water quality criterion of 3.2 µg/l (NUS 1991).

Summary

Numerous hazardous wastes were disposed at the Chemfax site. The drainage ditches on the site discharge to Bernard Bayou, an important habitat to NOAA trust resources in the area. One sediment sample was collected where the combined drainage ditches discharge into Bernard Bayou. Elevated concentrations of various organic compounds and some trace elements were detected in on-site soil, groundwater, and in sediment collected from ditches leading to NOAA resources. Levels of silver, mercury, naphthalene, and 2-methylnaphthalene in sediment were above levels of concern where the ditch discharges to the Bayou. Given the duration of contaminant release, and the presence of transport pathways, site-related contaminants may be migrating downstream into NOAA habitats. To date, there has been no sampling to confirm or refute this.

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6

ALCOA (Point Comfort)/ Lavaca Bay

Lavaca Bay, Texas
CERCLIS #TXD008123168

Site Exposure Potential

The ALCOA/Lavaca Bay Superfund site is located in Calhoun County, Texas. It is near the City of Point Comfort on the eastern shore of Lavaca Bay, an embayment of the Matagorda Bay estuarine system (Figure 1). In addition to the ALCOA Point Comfort Operations Plant, the Superfund site includes Dredge Spoil Island and nearby portions of Lavaca Bay, Cox Bay, Cox Creek, Cox Cove, Cox Lake, and western Matagorda Bay. (Cox Bay, Cox Creek, Cox Cove, and Cox Lake are also known as Huisache Bay, Huisache Creek, Huisache Cove, and Huisache Lake, respectively.) Next to the ALCOA facility are industrial and agricultural areas to the north and northeast, Cox Lake to the east, the Port Lavaca-Point Comfort turning basin and industrial areas to the south, and Lavaca Bay to the west and southwest (Figure 2). The ALCOA facility consists of process areas, surface impoundments, and landfills covering approximately 1,400 hectares. The facility now processes and refines bauxite. Historical operations included a chlor-alkali processing plant (operated from 1966 to 1979), an oil and gas plant, an aluminum smelter (operated from 1949 to 1980), a coal tar processing facility (operated by WITCO from 1964 to 1985), and a cryolite plant (operated from 1962 to 1980; ALCOA 1994). The dredge spoil island is approximately 400 m west of the processing plant. This island

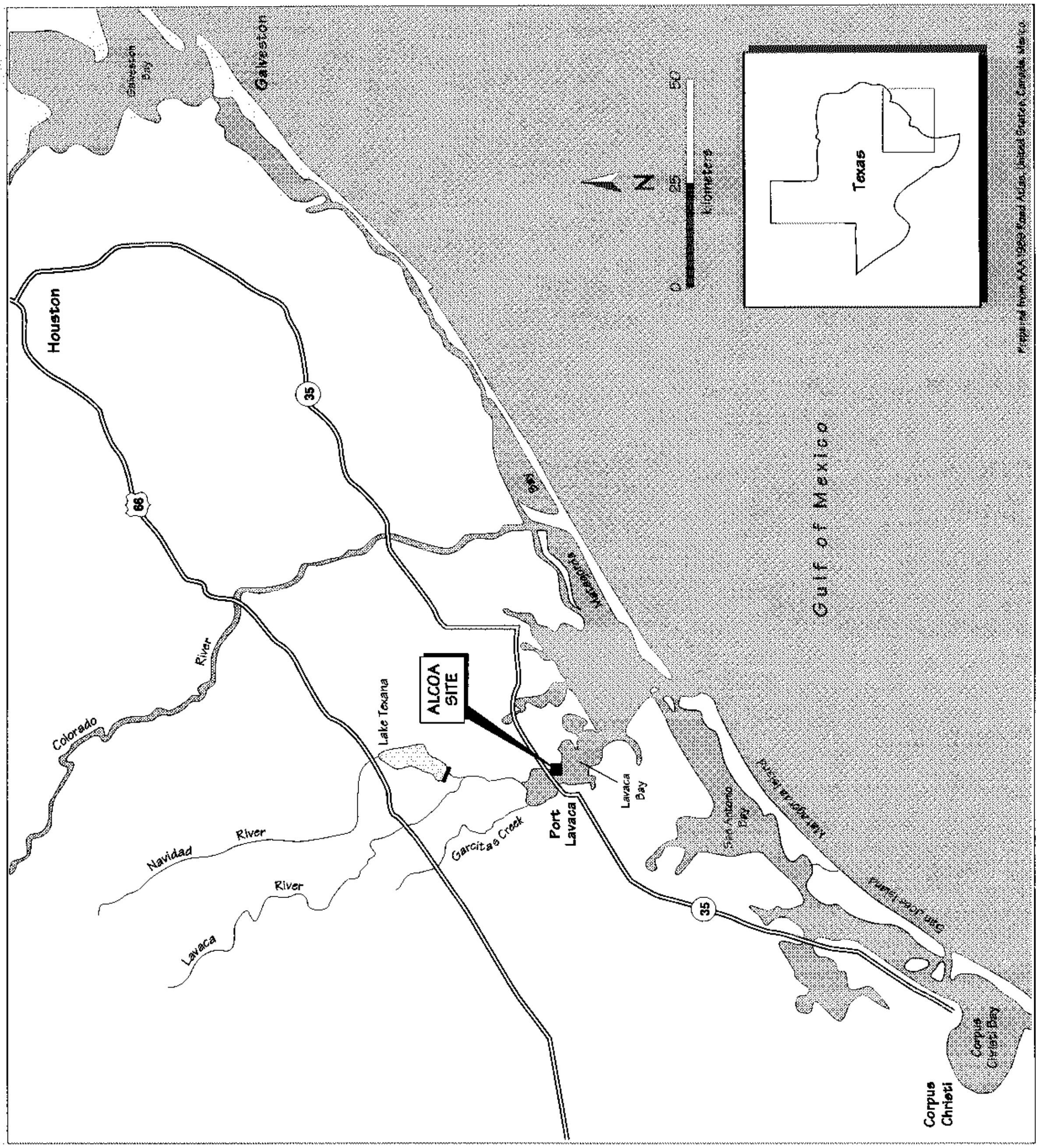
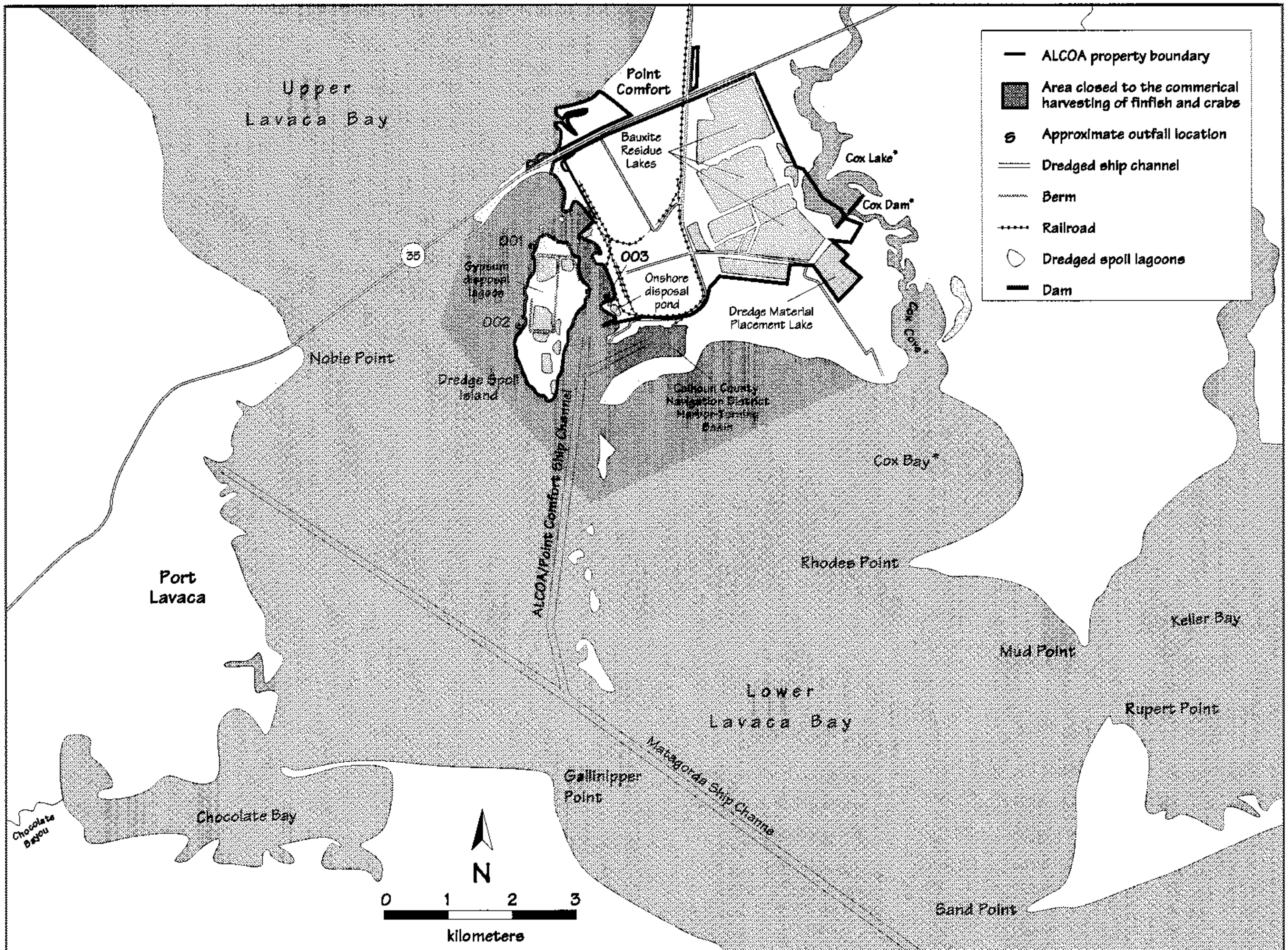


Figure 1. Location of the Aluminum Company of America (ALCOA) on the eastern shore of Lavaca Bay, Texas.



* Cox Bay, Cox Cove, Cox Dam, and Cox Lake are also known as Huisache Bay, Huisache Cove, Huisache Dam, and Huisache Lake.
Prepared from NOAA, Port Lavaca nautical chart no.11317; Mercury in Lavaca Bay Sediment and Organisms: a Progress Report, Figure 3, Dave Reigel Dept. of Oceanography Texas A&M University; Aluminum Company of America, June 29, 1994; USGS 1:100 000 scale (topographic): Port Lavaca, Texas (1984); San Antonio Bay, Texas (1983).

Figure 2. Detail of Aluminum Company of America site.

was created of spoil from periodic dredging of the ALCOA ship channel and other navigation channels in Lavaca Bay. The major features on the island are a 37-hectare gypsum disposal lagoon, and an approximately 20-hectare dredge spoil disposal area with five lagoons (Figure 2).

At the chlor-alkali process area (CAPA), brine was treated by electrolysis to manufacture chlorine gas and sodium hydroxide from 1966 to 1979 (USEPA 1993a). Mercury was used as a cathode for electrolysis, and was discharged as part of the waste stream. Over the life of the CAPA plant, mercury-containing wastes were discharged to the gypsum disposal lagoon on the offshore island, into an onshore disposal pond, and into several Bauxite Residue Lakes. From 1966 to 1970, the wastewater was primarily discharged into the gypsum disposal lagoon, and through lagoon Outfalls 001 and 002 into Lavaca Bay (Figure 2). According to waste stream calculations, an estimated 30 kg per day of mercury were discharged to this lagoon, and an estimated 44,000 kg of mercury were discharged to Lavaca Bay between 1966 and 1970 through Outfalls 001 and 002 (USEPA 1993a). Also between 1966 and 1970, mercury-contaminated wastewaters were intermittently discharged to an onshore disposal pond, and then into Lavaca Bay at Outfall 003 (Roy F. Weston, Inc. 1993). When the plant processes were modified in 1970 the mercury in the waste stream was reduced to approximately 6 kg per day. From 1970 to 1979, mercury wastes were discharged to Bauxite Residue Lakes 1, 2, and 3. A 1970 explosion at the plant released an unknown amount of mercury into Lavaca Bay.

Carbon tetrachloride was also used at the CAPA, and PCB-containing materials were shipped to ALCOA's Point Comfort plant (ALCOA 1994). Other potential contaminant sources include liquid and solid wastes in surface impoundments and disposal of solid wastes in landfills (ALCOA 1994).

There are three relatively shallow, water-bearing, transmissive zones, generally separated by clay layers under the CAPA area and the operations plant. Shallow groundwater is approximately 5 m below the surface. Groundwater from the middle transmissive zone discharges into the ALCOA ship channel near the CAPA. In general, groundwater flows from a mound in the interior of the peninsula toward discharge areas along adjacent surface water bodies and the bays (Radian Corp. 1994).

The potential contaminant transport pathways from the ALCOA site to NOAA trust resources and their habitats are groundwater migration, surface runoff, and air transport of contaminated dust. Groundwater is probably the primary transport pathway. During the CAPA operational period, the primary pathway of contaminant transport to trust habitats was the direct discharge of mercury-containing wastewater through Outfalls 001, 002, and 003.

Sediments containing mercury attributed to ALCOA wastewater discharges have been dredged periodically and placed into dredge spoil areas located on the offshore dredge spoil island and in the dredge material placement lake in the southeast corner of the facility. Because of their proximity to the bay, the dredge spoil areas on the island have a high potential to release mercury-containing sediments into Lavaca Bay (USEPA 1993a). Several instances have occurred in which these dredge spoil lagoons have breached, releasing mercury-contaminated sediment and water to Lavaca Bay (USEPA 1993a).

Mercury that has been released may continue to spread in Lavaca Bay through channel dredging; shrimp trawling and oyster dredging; dispersion via wind, tides, and river currents; and transfer through the aquatic food chain. In addition, Central Power and Light's E.S. Joslin power station pumps approximately 870 million liters per day of once-through cooling water from the turning basin at Point Comfort to Cox Bay, creating a circulation from Cox Bay back to the turning basin that may influence mercury distribution in this area (Ward 1994).

NOAA Trust Habitats and Species

Habitats of concern to NOAA are the surface water, associated bottom substrates, and estuarine emergent wetlands associated with Matagorda, Lavaca, and Cox bays; Cox Cove; and Cox Creek. Wetlands and creeks near the site provide significant spawning, nursery, and adult forage habitat for diverse, abundant populations of NOAA trust species (Table 1; Ward et al. 1980; Nelson et al. 1992; Dailey personal communication 1994; Weixelman personal communication 1994). The Matagorda Bay system is a principal embayment of the Texas and Gulf of Mexico coasts. The bay is a broad (1,200 km^2), shallow (mean depths of 3 m) lagoon estuary nearly isolated from the Gulf of Mexico by barrier island-peninsulas typical of Gulf Coast embayments (Ward et al. 1980; U.S. Department of Commerce 1992).

Matagorda Bay is comprised of several important subsystems that are hydrographically or morphologically well-identified. Lavaca Bay, in the northwestern arm of the system, receives discharges from the Lavaca and Navidad rivers and several other creeks associated with specific local drainage areas (e.g., Garcitas Creek and Chocolate Bayou). The mouth of Lavaca Bay is partially confined by the Indian Point and Sand Point prominences, and the Sand Point Reef complex. Tertiary embayments of Lavaca Bay include Chocolate, Keller, and Cox bays (Ward et al. 1980; U.S. Department of Commerce 1992).

Salinities in Lavaca Bay near the site range from 0 to 25 ppt and fluctuate throughout the year depending on rainfall, saltwater intrusion, and freshwater inflow via the Lavaca and Navidad rivers (Dailey personal communication 1994). The shallowness of the Matagorda Bay system, combined with frequent strong winds, induces a nearly homogeneous vertical salinity regime.

Table 1. Primary NOAA trust resources in Lavaca and Matagorda bays near the ALCOA site, Point Comfort, Texas.

Species		Habitat Use			Fishery	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ESTUARINE/MARINE SPECIES						
Bay anchovy	*Anchoa mitchilli*	♦	♦	♦		
Sheepshead	*Archosargus probatocephalus*		♦	♦		♦
Hardhead catfish	*Arius felis*	♦	♦	♦		
Silver perch	*Bairdiella chrysoura*	♦	♦	♦		
Gafftopsail catfish	*Bagre marinus*	♦	♦	♦		♦
Gulf menhaden	*Brevoortia patronus*		♦	♦		
Crevalle jack	*Caranx hippos*		♦	♦		♦
Bull shark	*Carcharhinus leucas*		♦	♦		♦
Sand seatrout	*Cynoscion arenarius*		♦	♦		♦
Spotted seatrout	*Cynoscion nebulosus*	♦	♦	♦		♦
Sheepshead minnow	*Cyprinodon variegatus*	♦	♦	♦		
Gizzard shad	*Dorosoma cepedianum*	♦	♦	♦		
Killifish	*Fundulus spp.*	♦	♦	♦		
Goby	*Gobiosoma spp.*	♦	♦	♦		
Pinfish	*Lagodon rhomboides*		♦	♦		♦
Spot	*Leiostomus xanthurus*		♦	♦		
Tarpon	*Megalops atlanticus*		♦			
Silverside	*Menidia spp.*	♦	♦	♦		
Atlantic croaker	*Micropogonias undulatus*		♦	♦		♦
Striped mullet	*Mugil cephalus*		♦	♦		
Gulf flounder	*Paralichthys albigutta*		♦	♦	♦	♦
Southern flounder	*Paralichthys lethostigma*		♦	♦	♦	♦
Black drum	*Pogonias cromis*		♦	♦	♦	♦
Red drum	*Sciaenops ocellatus*		♦	♦		♦
INVERTEBRATE SPECIES						
Blue crab	*Callinectes sapidus*	♦	♦	♦	♦	♦
American oyster	*Crassostrea virginica*	♦	♦	♦	♦	♦
Bay squid	*Lolliguncula brevis*	♦	♦	♦		
Gulf stone crab	*Menippe adina*	♦	♦	♦	♦	
Hard clam	*Mercenaria mercenaria*	♦	♦	♦		
Grass shrimp	*Palaemonetes pugio*	♦	♦	♦		
Brown shrimp	*Penaeus aztecus*		♦	♦	♦	♦
Pink shrimp	*Penaeus duorarum*		♦	♦	♦	
White shrimp	*Penaeus setiferus*		♦	♦	♦	♦
Common rangia	*Rangia cuneata*	♦	♦	♦		

The range of tidal amplitude in the Matagorda Bay complex is generally less than 0.5 m. Estuary substrate is mainly mud and sand with isolated areas of aquatic vegetation. Submerged aquatic vegetation in the Matagorda Bay system is mostly shoal grass (*Halodule beaudettei*) and widgeon grass (*Ruppia maritima*), while Lavaca Bay substrates have very little vegetation (Ward et al. 1980; Dailey personal communication 1994).

Matagorda Bay is transected by a network of dredged navigation channels. The 11.5-m deep Matagorda Bay Ship Channel, which extends about 27 km northwest from the Gulf of Mexico to lower Lavaca Bay, is the largest channel in Matagorda Bay. The 4-m deep Port Lavaca Ship Channel extends northwest beyond the northern limit of the Matagorda Bay Ship Channel, allowing navigational maritime traffic to access Port Lavaca (U.S. Department of Commerce 1992). Additional prominent channels in the area include Red Bluff Channel, King Fisher Marine Channel, and the Harbor of Refuge Channel.

Those species in greatest numbers in the Matagorda Bay complex include bay anchovy, Gulf menhaden, brown shrimp, white shrimp, grass shrimp, and blue crab (Dailey personal communication 1994). Bay anchovy, a pelagic estuarine species, is present year-round and reaches peak spawning densities in the Matagorda system from October through March. Gulf menhaden, a schooling pelagic clupeid, use surface water near the site as a year-round rearing area, while adults are abundant from April through October (Nelson et al. 1992). Surface water near the site also provides important rearing habitat to white, brown, pink, and grass shrimp. White shrimp are abundant in the estuary throughout all seasons, with peak rearing densities from March through late November. Adult white shrimp reach peak densities in the spring and fall. Adult pink shrimp are common from February through May. Brown shrimp return to the Matagorda Bay complex from early April through late July, while juveniles are abundant throughout the year except during January and February. Grass shrimp reside in the estuary year-round (Nelson et al. 1992). There are adult blue crab in the estuary year-round, with greatest densities from February through late August. Juveniles are also common throughout the year, with highest concentrations from February through late September. Adults commonly mate from March through November (Berringer 1994).

Spotted seatrout, an important game fish in the estuary, use surface water near the site to spawn, rear, and forage throughout the year. This species normally spawns from April through September. Southern flounder migrate out of the estuary to spawn during the winter and return in the spring. Juvenile southern flounder are present year-round. Adult red drum use the passes between many of the estuarine barrier islands to spawn from August through mid-November. Juvenile red drum typically remain in the estuary year-round for the first four years of life (Dailey personal communication 1994). Juvenile and adult black drum are present in the estuary year-round. Adults spawn in the estuary from February though late March. Atlantic croaker, one of the several sciaenid fishes of the Gulf that support a significant commercial and recreational fishery, also use surface water near the site as a year-round rearing area. Adults are seasonally abundant from April through November (Ward et al. 1980; Nelson et al. 1992).

Bay anchovy, silverside, killifish, striped mullet, sheepshead minnow, and grass shrimp are important components of the forage base in the estuary.

These species are most commonly preyed upon by red drum, spotted seatrout, southern flounder, sheepshead, black drum, and hardhead catfish (Dailey personal communication 1994).

The fisheries within Lavaca Bay and the adjoining embayments that compose the Matagorda Bay complex are a significant resource to the commercial and recreational fishing industry in Texas (Ward et al. 1980; Dailey personal communication 1994; Weixelman personal communication 1994). In 1975, 1,459,000 kg of seafood was harvested from the Matagorda Bay system (Ward et al. 1980). Lavaca Bay also supports several major fisheries that harvest numerous finfish species, blue crab, and shrimp (Ward et al. 1980; Dailey personal communication 1994; Weixelman personal communication 1994). Lavaca Bay north of Highway 35 is closed to shrimping because of its significance as a juvenile shrimp nursery area. Southern and central Lavaca Bay support a moderate shrimp fishery (Dailey personal communication 1994). Though bay surface waters are closed to net finfishing, the Lavaca River supports a sporadic freshwater commercial fishery using trot lines (Ward et al. 1980; Dailey personal communication 1994).

Southern flounder, Gulf flounder, black drum, oyster, blue crab, white shrimp, brown shrimp, pink shrimp, and Gulf stone crab are commercially harvested near the site. The black drum fishery uses only trot lines, while southern flounder are caught with gigs (spears). The state strictly manages the shrimp fishery, and enforces specified seasons and catch limits. Recreational fishing in the Matagorda Bay complex is popular year-round, with the greatest fishing pressure on spotted seatrout, southern flounder, and red drum. Atlantic croaker, sheepshead, sand seatrout, black drum, blue crab, and gafftopsail catfish attract a moderate sport effort. Additional species caught recreationally include crevalle jack, bull shark, pinfish, brown shrimp, white shrimp, and oyster (Dailey personal communication 1994).

In 1989, the Texas Department of Health closed portions of Lavaca Bay south and west of the ALCOA facility to the taking of fish and crab because mercury levels in edible tissues exceeded the established guideline of 1.0 ppm (Figure 2). These restrictions are difficult to enforce: people probably still periodically eat seafood taken from within these areas (Berringer personal communication 1994).

Many areas of the Matagorda Bay complex are also subject to periodic shellfish closures after it rains, due to fecal coliform contamination. Shellfish harvesting is restricted around the ALCOA site during and after periods of high rainfall.

Surface water of Lavaca and Matagorda bays provides habitat for four species of marine turtle listed as threatened or endangered under the Federal Endangered Species Act. The loggerhead turtle (*Caretta caretta*) and the green turtle (*Chelonia mydas*), federally listed as threatened; and the Kemp's ridley turtle (*Lepidochelys kempii*) and the leatherback turtle (*Dermochelys coriacea*), listed as endangered, are seen in the estuary year-round. Atlantic bottlenose dolphin (*Tursiops truncatus*) visit the Matagorda Bay complex year-round and forage on estuarine finfish (Dailey personal communication 1994).

Site-Related Contamination

Mercury is the contaminant of main concern at the ALCOA site. Data collected for the expanded site inspection (Roy F. Weston, Inc. 1993), the Lavaca Bay Sediment Sampling Data Report (Woodward-Clyde 1992), and other site investigations (Radian Corp. 1994), indicate that groundwater, surface water, sediments, and soils are contaminated with mercury and, to a lesser extent, with PCBs, PAHs, and VOCs such as carbon tetrachloride.

Groundwater sampled near the CAPA in 1993 contained dissolved mercury concentrations (maximum 361 µg/l) that exceeded the marine acute AWQC (2.1 µg/kg) by more than two orders of magnitude (McCulley et al. 1994). Surface water samples from the Point Comfort area had mercury concentrations exceeding acute and chronic marine AWQC concentrations. Mercury concentrations in Lavaca Bay sediment exceeded NOAA's ERM screening guideline by up to 35 times. Concentrations exceeding ERL guidelines have been detected approximately 5 km from the dredge spoils island, in both upper and lower Lavaca Bay. Lavaca Bay biota also have been shown to have elevated mercury concentrations (Table 2).

PAHs have been detected in sediment collected near ALCOA, at a maximum total PAH concentration of 31 mg/kg (GERG 1990), which exceeds the ERL guideline of 4.0 mg/kg (Long and MacDonald 1992). Total PAHs in oyster tissue (maximum 1.4 µg/kg) and fish muscle tissue (maximum 37 µg/kg) from samples collected in Lavaca Bay near the ALCOA facility indicate probable uptake of PAHs from the sediments (GERG 1990).

Summary

Lavaca Bay supports numerous NOAA trust resources, and is especially important as a nursery ground and adult forage area. Mercury is the primary contaminant of concern associated with ALCOA's Point Comfort chlor-alkali plant. PCBs and PAHs have also been used at the site and detected in environmental and biological media. The most recent sampling indicates that mercury contamination is widespread in Lavaca Bay sediment and biota, and is concentrated near the ALCOA Point Comfort operation and in nearby Cox Bay. Groundwater transport is a source of mercury loading to Lavaca Bay, and contaminated sediment is a continuing source of mercury contamination to biota in the Bay.

Table 2. Maximum mercury concentrations in marine surface water, sediment, and biota from selected areas around the ALCOA Point Comfort operation.

Location	Surface water (µg/l)	Sediment (mg/kg) dry weight	Biota (mg/kg) wet weight Finfish	Oysters	Crab
RECENT DATA					
ALCOA/Point Comfort	0.85[a]	1.20[b]	1.5[c]	1.4[c]	NA
ALCOA Channel	NA	17[d]	NA	NA	NA
Offshore of Outfall 001	NA	25[d]	NA	NA	NA
Offshore of Outfall 002	NA	0.55[d]	NA	NA	NA
Onshore near Outfall 003	NA	23[d]	NA	NA	NA
Lavaca Bay North of Hwy 35	NA	6.6[d]	1.6[e]	0.08[e]	2.0[e]
Lavaca Bay South of Hwy 35	NA	7.3[d]	NA	NA	4.5[f]
Lavaca Bay North of Hwy 35	NA	0.41[b]	NA	NA	NA
Cox Bay	0.52[a]	0.58[b]	NA	NA	NA
DATA PRIOR TO 1980[g]					
Point Comfort	3.0	7.1	5.6	0.24	1.9
Cox Bay	0.3	3.4	2.41	NA	NA
SCREENING GUIDELINES[h]			NA	NA	NA
Marine Acute AWQC	2.1				
Marine Chronic AWQC	0.025				
ERL		0.15			
ERM		0.71			

NA: Not available or not analyzed
a: Bowman 1988.
b: Roy F. Weston 1993.
c: GERG 1990.
d: Woodward-Clyde 1992.
e: Evans and Engel 1994.
f: USEPA 1993a.
g: Bowman 1988. Results from sampling during the 1970s.
h: Marine ambient water quality criteria for the protection of aquatic organisms (U.S. EPA 1993b); Effects range-low (ERL) and Effects range-median (ERM; Long and MacDonald 1992).

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10

Fort Richardson

Anchorage, Alaska
CERCLIS #AK6214522157

Site Exposure Potential

Eagle River Flats is the primary site of concern at Fort Richardson in Anchorage, Alaska. This 870-hectare estuarine marsh forms the mouth of the Eagle River in Upper Cook Inlet (Knik Arm) (Figures 1 and 2). Although artillery activities ceased in 1989, the U.S. Army used the salt marsh as an artillery range for about 50 years, contaminating sediments with white phosphorus particles. No estimates of the total amount of white phosphorus discharged to the marsh have been available. Since 1981, however, more than one thousand waterfowl deaths each year have been attributed to white phosphorus poisoning. Waterfowl use the area primarily as a migratory stop for several weeks in the spring and fall (U.S. Army 1994a).

Eagle River Flats is composed of numerous ponds, mudflats, and channel tributaries of the Eagle River. Tidal fluctuations, among the highest in the world (up to 11 m), periodically flood the entire marsh during the highest tides. White phosphorus has been found throughout the marsh, but particularly high concentrations have been found in ponded areas in central portions of the flat east of Eagle River. Investigations have divided the Eagle River Flats into ten general areas described in Table 1 and Figure 2.

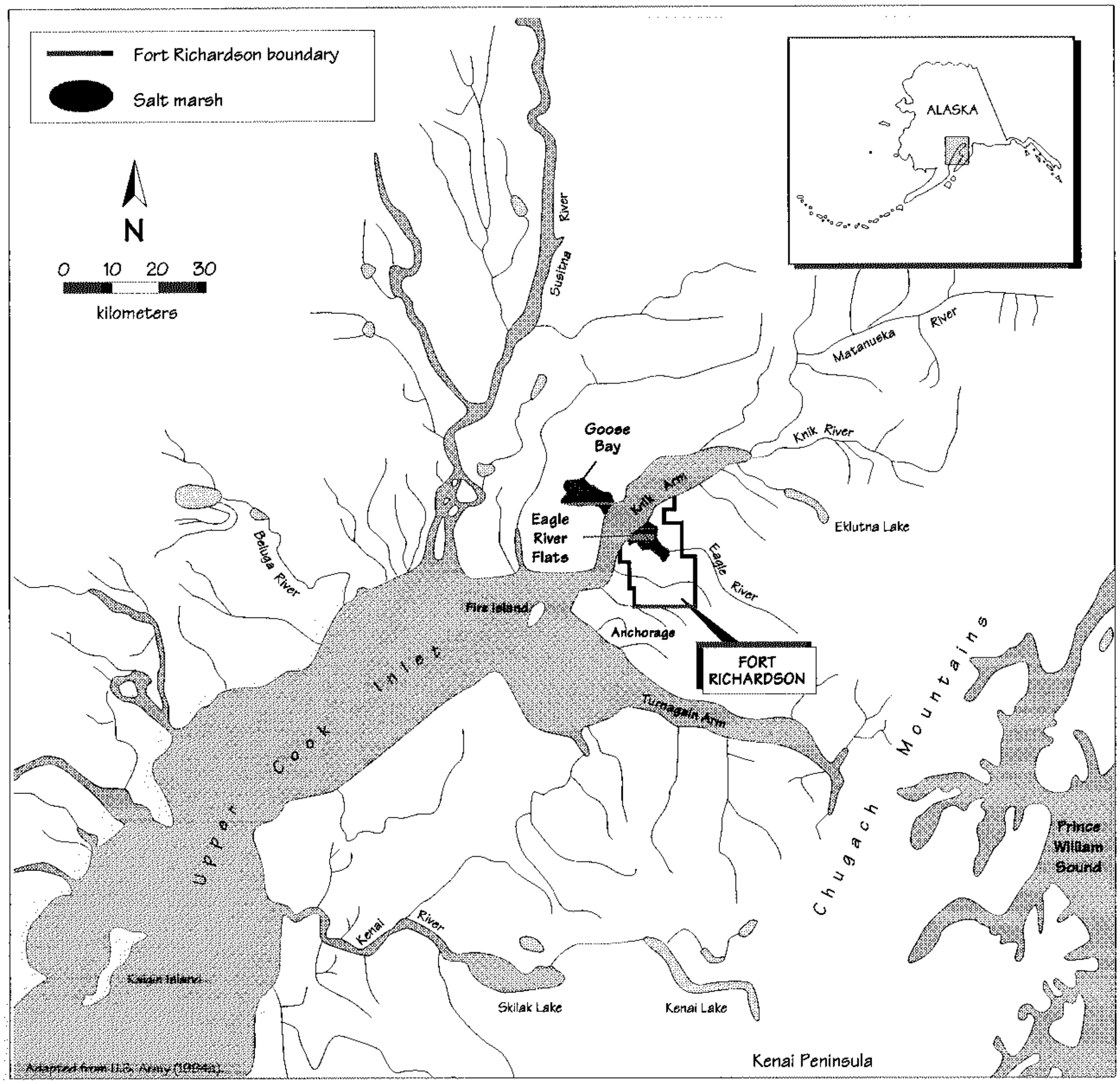

Figure 1. Fort Richardson and the Eagle River Flats site on Knik Arm, Upper Cook Inlet, near Anchorage, Alaska.

Currents produced by tides transport white phosphorus throughout the marsh and mudflats. Neither the extent of contamination in the main channel of the Eagle River nor its potential migration to Knik Arm is known. Plumes of white phosphorus within the sediments are not readily observed because the original distribution of white phosphorus was caused by directed artillery impact, and because of the physical behavior of white phosphorus. White phosphorus occurs mainly as a soft, waxy particulate that is

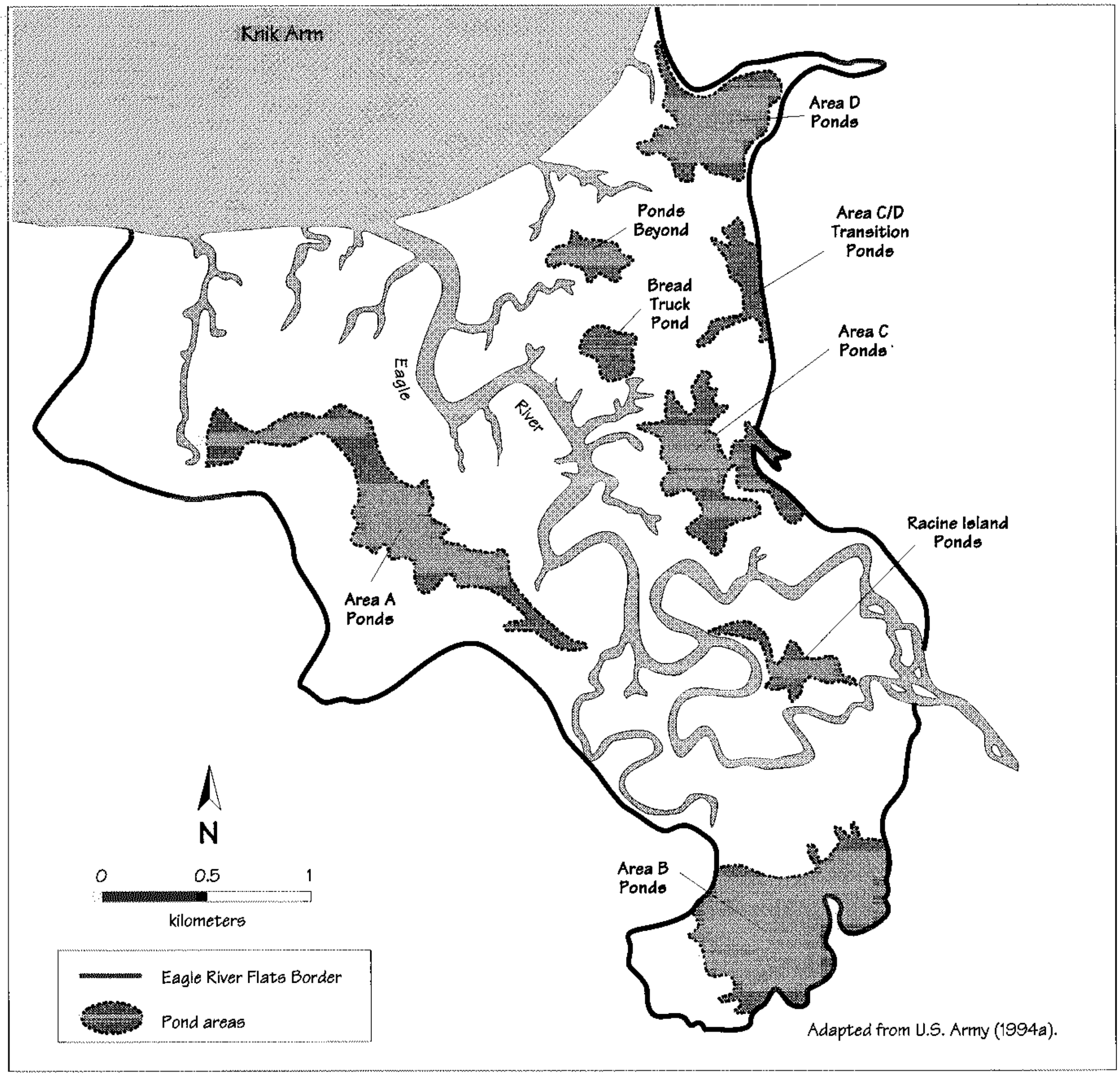

Figure 2. The Eagle River Flats site and ponded areas sampled for white phosphorus.

insoluble in water. The concentration is determined by the number and size of particles in sediment. Therefore, migration is a complex function of sediment erosion and/or bioturbation, subsequent particle suspension, and suspended-sediment transport in the water column (U.S. Army 1994a).

Except for the Eagle River Flats area, investigations of potential contamination at Fort

Table 1. Investigations at the Eagle River Flats (U.S. Army 1994a).

Area on Site	Location of Investigation
Area A Ponds	Western side of the Eagle River.
Area B Ponds	Southern end of Eagle River Flats.
Area C Ponds	Single large pond and a series of small ponds along the eastern edge of the flat.
Area D Ponds	Single, large permanent pond and a series of smaller ponds in an embayment on the northeast corner of the flat.
Area C/D Transition Ponds	Transition zone halfway between Areas C and D. Complex of deeper narrow ponds along the east side of the flat.
Bread Truck Pond	6.5-hectare, semi-permanent pond located near the Eagle River and approximately 500 m west of Area C/D.
Ponds Beyond	Small area of shallow ponds less than 200 m northeast of Bread Truck Pond.
Racine Island Ponds	Small ponds within a mudflat island formed by two channels of the Eagle River.
Mudflats	Mudflats are site-wide and are composed of areas that are not river channel, tributaries, and ponds. These areas are inundated only during the highest tides.
Channel Tributaries	Channel tributaries draining ponds and mudflats site-wide, draining to the Eagle River.

Richardson have not yet started. Only one other potential source has been identified: a building located near Ship Creek that was used to store PCB-contaminated soils. Sampling is planned to identify potential migration routes from this site to Ship Creek (Wilkening personal communication 1994).

NOAA Trust Habitats and Species

Habitats of concern to NOAA are surface water, associated bottom substrates, estuarine emergent wetlands, and intertidal mudflats associated with the Eagle River and the Knik Arm of Cook Inlet. Numerous anadromous trust species (Pacific salmon, Dolly Varden trout, and steelhead trout) seasonally migrate from the Knik Arm into the Eagle River. Knik Arm, a glacial estuary extending approximately 40 km north from upper portions of Cook Inlet, is a highly turbid estuarine system, with tidal currents exceeding 3.4 m/sec. Salinities, driven by the tide stage, range from 6 to 20 ppt. Massive quantities of sediment are continually loaded to the estuary via major glacial river discharge and erosion of coastal bluffs.

The Eagle River Flats is a dynamic, estuarine salt marsh actively undergoing progressive and significant changes due to high sedimentation rates and the cold climate. The primary source of sediment in the area is attributed to high tidal inundation from either Knik Arm or the Eagle River, or both. Vegetative cover associated with the mudflats near the mouth of the river varies from bare sediment, to sparse cover provided by annual plants and alkali grass (*Puccinellia hultenii*), to well-vegetated stands of arrowgrass (*Triglochin maritima*), beach rye (*Elymus arenarius*), and/or goose tongue (*Plantago maritima*). Ramenski's sedge (*Carex ramenskii*), bullrush (*Scirpus paludosus* and *S. validus*), and Lyngbyaei's sedge (*Carex lyngbyaei*) predominate upstream from the mudflats (U.S. Army 1994a).

Salmonids, the most abundant trust species present in the Eagle River, use riparian habitats primarily as juvenile rearing habitat, adult forage area, and migratory corridor to reach spawning areas farther upstream (Table 2). Upstream from the site, the South Fork of the Eagle River serves as spawning ground and nursery habitat for chinook, chum, coho, and pink salmon; Dolly Varden; and steelhead trout (Gossweiler personal communication 1994; Hoffmann personal communication 1994). The Eagle River provides habitat to the threespine stickleback and slimy sculpin (Rothe et al. 1983; CH2M Hill 1992).

The Eagle River historically provided habitat to significant populations of Pacific salmon, steelhead trout, and Arctic grayling. Populations currently inhabiting the river have dramatically dropped in recent years. The natural chinook salmon population has been reduced to approximately 300 annually returning adults. The Alaska Department of Fish and Game has stocked approximately 100,000 chinook fingerlings into the Eagle River annually since 1990 to help increase the population. Chinook salmon smolt after one year in freshwater and typically spend four to five years in the ocean before maturing and returning to freshwater to spawn. Although some returns have already been observed in the Eagle River, the first "full return" is expected to begin in 1995 (Hoffmann personal communication 1994).

Pacific salmon in the Anchorage area spawn from the late summer to early fall. The salmon eggs are deposited in redds (nests) where they develop during the winter and subsequently hatch in the spring. Alevins, or sac-fry, remain within the redd until the yolk sac is absorbed, then emerge as fry. Depending on the species, alevins may emerge from the redd within a few weeks or a few months after hatching. The fry develop into fingerlings during the summer, and then into smolts before they leave the freshwater creeks to enter the ocean. The smolt stage represents a physiological change that occurs in preparation for life in salt water. Pink and chum salmon in the Upper Cook Inlet region "smolt" soon after the fry emerge from the redds. Chinook salmon smolt after one year in fresh water, coho after two years, and sockeye after one to three years. Depending on the species, Pacific salmon spend one to four years in the ocean before maturing and returning to fresh water to spawn (Hoffmann personal communication 1994).

Knik Arm provides adult forage habitat and a migratory corridor for Dolly Varden trout and steelhead trout (Hoffmann personal communication 1994). Dolly Varden spawn in the fall and eggs hatch the following spring. The fry and fingerling stages occur in spring and summer. Dolly Varden remain in fresh water and mature

Table 2. NOAA trust resources in the Eagle River near the Fort Richardson site, Fort Richardson, Alaska.

Species		Habitat Use				Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Migratory corridor	Comm.	Recr.
SALMONID SPECIES							
Pink salmon	*Oncorhynchus gorbuscha*		♦	♦	♦		
Chum salmon	*Oncorhynchus keta*		♦	♦	♦		
Coho salmon	*Oncorhynchus kisutch*		♦	♦	♦		
Sockeye salmon	*Oncorhynchus nerka*		♦	♦	♦		
Chinook salmon	*Oncorhynchus tshawytscha*		♦	♦	♦		
Steelhead trout	*Oncorhynchus mykiss*		♦	♦	♦		
Whitefish	*Prosopium spp.*		♦	♦	♦		♦
Dolly Varden	*Salvelinus malma*		♦	♦	♦		♦
Artic grayling	*Thymallus articus*		♦	♦	♦		♦
MARINE / ESTUARINE SPECIES							
Bering cisco [1]	*Coregonus laurettae*		♦	♦			
Slimy sculpin	*Cottus cognatus*	♦	♦	♦			
Saffron cod [1]	*Eleginus gracilis*		♦	♦			
Threespine stickleback	*Gasterosteus aculeatus*			♦			
Ringtail snailfish [1]	*Liparis rutteri*		♦	♦			
Ninespine stickleback	*Punigitius pungitius*	♦	♦	♦			
Eulachon [1]	*Thaleichthys pacificus*			♦			

1: While it is known that adults of these species are found in Knik Arm, there is insufficient information to determine whether these species are using the area for spawning habitat.

four to five years before outmigration to the ocean. Adult Dolly Varden spawn for several consecutive years. Both immature and mature Dolly Varden compete with salmon and trout for food and are predatory on salmon eggs and young salmon. Steelhead trout spawn from April through June. Fry emerge from the redd in the summer and juvenile trout remain in fresh water two or three years before outmigration to the ocean (Hoffmann personal communication 1994).

Other NOAA trust species—threespine stickleback, eulachon, and Bering cisco—migrate through the Knik Arm to spawning grounds in area streams including the Eagle River. Except for the stickleback, it is not known whether these species reside in the estuary year-round. The life span of sticklebacks is approximately one to three years. They spawn in June and July in a nest made of twigs and plant debris constructed by the male. Sticklebacks represent an important component of the forage base for steelhead and rainbow trout in those lakes and streams where they occur together.

The ecology of saffron cod, which inhabits the Knik Arm as an adult, suggests that it might also spawn in the lower portions of the Eagle River, but this behavior has not been documented (Rothe et al. 1983; CH2M Hill 1992). Little is known about the life history of the slimy sculpin in Alaska, except that they spawn in the spring. Their main food source is benthic invertebrates, particularly aquatic insect larvae (Rothe et al. 1983; CH2M Hill 1992).

Cook Inlet is one of only eight recognized wintering areas in the world for beluga whales (*Delphinapterus leucas*). The small Cook Inlet population is resident year-round (Morris 1988). Beluga whales are known to concentrate at the mouth of the Eagle River annually from mid-May through September (Smith personal communication 1993). In recent years, beluga whales have been observed migrating as far as 2 km up the Eagle River from spring through late fall to feed on salmon (Gossweiler personal communication 1994).

Arctic grayling, whitefish, and Dolly Varden support a small recreational fishery near the site. In 1991, approximately 600 salmon were harvested from the river and over 80,000 salmonids were harvested from the Knik Arm (Table 3; Karcz personal communication 1993). There is commercial fishing in Knik Arm, but not in Eagle River; in 1993, 49,600 salmon were commercially harvested from Knik Arm (Table 4; Fox personal communication 1994).

Table 3. Numbers of salmon caught recreationally in surface water near Fort Richardson during 1991 (Karcz personal communication 1993).

Catch Area	Chinook	Coho	Pink	Sockeye	Chum	Rainbow Trout	Artic Grayling	Whitefish	Dolly Varden	Total Catch
Eagle River	6	0	0	0	0	0	30	7	584	627
Knik Arm	2,277	22,186	926	4,968	1,099	39,636	2,846	900	9,138	83,976

Table 4. Numbers of salmon caught commercially in Knik Arm (Fox personal communication 1994).

Year	Chinook	Coho	Pink	Chum	Sockeye	Total Catch
1987	0	2,043	264	403	24,090	26,800
1988	9	11,604	591	2,733	38,251	53,188
1989	4	6,075	545	4,979	47,925	59,528
1990	4	5,708	696	5,308	23,450	35,162
1991	0	1,630	21	961	10,459	13,071
1992	0	1,817	573	1,289	10,748	14,427
1993	0	831	29	990	47,751	49,601

Site-Related Contamination

White phosphorus is the primary contaminant that poses a threat to NOAA trust resources. Site investigations at Eagle River Flats between 1990 and 1993 collected sediment from over 600 surficial samples in ponds, 58 cores (multiple samples per core), 87 tributary channel samples, and 104 mudflat samples (Table 5). White phosphorus-contaminated sediments were widespread across Eagle River Flats, but were particularly associated with visible craters made by artillery fire near ponded areas. Of the 658 surface sediment and core samples collected in the ponded areas, 34 percent had measurable concentrations of white phosphorus. Lower concentrations and frequencies were observed on the mudflats and tributary channels (U.S. Army 1994a).

White phosphorus was most widespread in ponds of Area C, Racine Island, and Bread Truck Pond where 40 to 50 percent of the samples collected were contaminated. Maximum concentrations were over 3,000 mg/kg. Lower concentrations of white phosphorus were observed in 11 percent of the samples collected in Area A Ponds and were not observed in Areas B and D (Table 5; Figure 2; U.S. Army 1994a).

Measurable concentrations of white phosphorus were observed in approximately ten percent of the sediment samples collected in the mudflats.

Table 5. Distribution and concentration of white phosphorus in sediments of Eagle River Flats (U.S. Army 1994a).

Site Area	No. of samples [1]	Frequency of Detection	Percentage of Detection	Maximum concentration (mg/kg)
Ponded Areas				
A	189	21	11	0.053
B	38	0	0	ND
C	476	236	50	219
D	43	0	0	ND
C/D	35	2	6	0.012
Bread Truck	130	56	43	57.6
Pond Beyond	14	1	7	0.02
Racine Island	27	12	44	3071.3
Mudflats	104	10	10	0.15
Tributaries	87	3	3	0.049

1: For the ponded areas, the number of sediment samples included individual surface samples and multiple samples collected from cores.
ND: Not detected. The detection limit was not reported.

White phosphorus was observed in flats near Pond Areas A and C, and Bread Truck Pond, with a maximum concentration of 0.15 mg/kg observed near Bread Truck Pond. White phosphorus was not detected in three samples collected from craters in Knik Arm. Measurable concentrations of white phosphorus were observed in only three percent of the sediment samples collected within gullies and tributary channels flowing to the Eagle River (maximum concentrations of 0.049 mg/kg; U.S. Army 1994a).

In 1993, five surface water stations were sampled near Area C Ponds. Undisturbed samples (filtered and unfiltered) had measurable concentrations of white phosphorus ranging from 0.005 to 2.2 µg/l. Disturbed samples (0.1-liter sample shaken for five minutes with 10 ml of isooctane) had measurable concentrations two orders of magnitude higher, ranging from 1.2 to 290 µg/l. For undisturbed and disturbed samples, the highest concentrations were observed in confined areas with little flow or dilution (U.S. Army 1994a).

A benthic community study and sediment bioassays using the amphipod *Hyalella azteca* and the midge larva *Chironomus riparius* were performed in 1993. The benthic investigation found that infaunal populations were limited in the numbers of species present; the mean number of species found at any station was six. The study also found that the average species diversity and number of species were greatest in sediments most highly contaminated with white phosphorus. However, the total number of organisms was lower—only 20 percent of that observed at stations where white phosphorus was undetected. These data were therefore inconclusive (U.S. Army 1994a).

Sediment toxicity studies showed effects. All organisms in both the amphipod and midge larva tests died when exposed to contaminated sediments. However, the water concentrations of white phosphorus in the test chambers were several orders of magnitude higher than those found in surface waters of Eagle River Flats. The high concentrations probably resulted from white phosphorus suspended (in particulate form) in the water, which may increase the availability, and hence, toxicity of the substance. Water concentrations decreased by an order of magnitude from the start to the end of the 30-day test, indicating a gradual redeposition of white phosphorus particulates. Nonetheless, white phosphorus concentrations were still up to three orders of magnitude higher than those found in the field over equally contaminated sediments (U.S. Army 1994a).

These results suggest that any disturbance of contaminated sediments could resuspend white phosphorus particulates and be very toxic. This is supported by findings that disturbed surface water samples had higher white phosphorus concentrations than undisturbed samples. The data also suggest that white phosphorus particulates sequestered in the sediments may be less bioavailable and therefore less toxic. Sediment disturbance and its effect on the bioavailability and toxicity of white phosphorus has not been investigated (U.S. Army 1994a) although there is a workplan to investigate sediment resuspension by waterfowl and tidal exchange (U.S. Army 1994b).

Bioaccumulation studies were also conducted at Eagle River Flats; 30 macroinvertebrate and 31 fish samples were analyzed for white phosphorus. Measurable concentrations of white phosphorus were observed in only one fish sample, indicating that white phosphorus is not readily accumulated in tissues of these organisms.

Concentrations of white phosphorus in the sediments are potentially toxic to aquatic resources of concern to NOAA. Bioassessment studies have shown acutely toxic effects. However, data suggest that toxicity is most severe when sediments are disturbed, suspending white phosphorus particles in the overlying water. White phosphorus may thus be less toxic when undisturbed in the sediments. The level of sediment resuspension and subsequent release and toxicity of white phosphorus under natural conditions have not been assessed. Eagle River Flats is subject to some of the largest known tidal ranges, which daily inundate the site and then recede, creating the potential for substantial sediment disturbance and subsequent adverse effects to aquatic resources of concern.

Summary

Eagle River Flats is contaminated with white phosphorus as a result of 40 to 50 years of artillery bombardment from Fort Richardson. This substance is widespread throughout the flats, with particularly high concentrations in ponded areas. White phosphorus is not very soluble and is present largely in particulate form within the sediments of the flats. Resuspension and ingestion of white phosphorus have caused annual die-offs of waterfowl, but potential effects to aquatic resources are not completely known.

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10

Jackson Park Housing Complex

Bremerton, Washington
CERCLIS #WA3170090044

Site Exposure Potential

Jackson Park Housing Complex occupies 120 hectares approximately three km northwest of Bremerton, Washington (Figure 1). The site is bordered on the south by forest, on the west by State Highway 3, on the north by the community of Erlands Point, and on the east by Ostrich Bay. Ostrich Bay is in Dyes Inlet, an embayment of central Puget Sound. Dyes Inlet drains into Sinclair Inlet via the Port Washington Narrows and flows approximately 11 km before entering the main Puget Sound basin. The site includes housing, community services, and related infrastructures such as paved streets, sewer systems, and other utilities. It is partially wooded with isolated areas of dense vegetation in the northern and southern portions (URS Consultants [URS] 1992).

The facility was established in 1904 as the Naval Magazine Puget Sound and operated as an ammunition storage facility from 1908 to 1947. In later years it also served as a location for ordnance demilitarization. During development of nearby Naval Ammunition Depot Bangor and Naval Torpedo Station Keyport in 1948, the Jackson Park facility was reauthorized as Bremerton Annex. In 1959, it was decommissioned and placed on caretaker status (URS 1992).

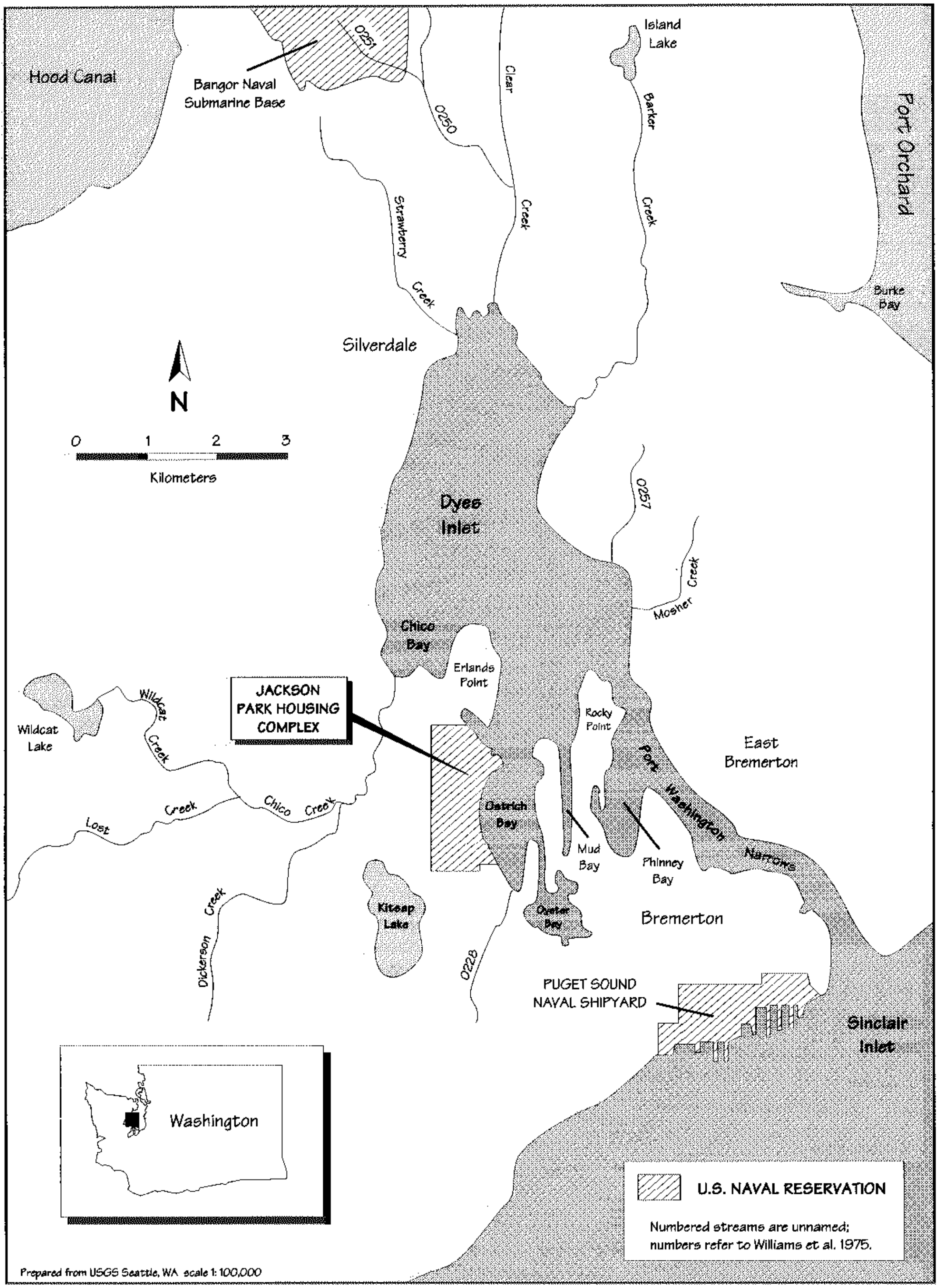

Figure 1. Site location of Jackson Park Housing Complex showing key waterways.

Past activities at the site included ordnance production, demilling, and storage, as well as disposal of ordnance dusts and liquid wastes. During World War II, dry ordnance wastes were collected and flash-burned in an area at Elwood Point near the present baseball field (Figure 2). During this time a permanent burn structure replaced the former burn area and more than 900 kg of ordnance compounds were burned monthly (URS 1992). Both ordnance and non-ordnance wastes were landfilled along the shoreline north of Elwood Point from 1910 to 1959. Composition of the non-ordnance wastes is unknown. Liquid wastes were collected and transported to a recycling system at one of the buildings formerly located between Pier 2 and Elwood Point. Wastewater from the recycling plant was collected periodically and disposed off-site. Ordnance residues were washed into building floor drains that discharged directly into Ostrich Bay (URS 1992).

Site investigations conducted in 1992 included soil, groundwater, surface water, sediments, and crab and bivalve tissue sampling. Benthic community assessments were also performed (URS 1992).

Surface-water runoff and groundwater are the primary pathways for contaminant transport to Ostrich Bay. A drainage system connected to floor drains in buildings that have since been demolished is of secondary concern. Site topography slopes toward the bay with elevations ranging from 60 m to sea level. Although the shoreline is fairly level, there are steep grades in the south, west, and central areas. Two unnamed tributaries flow east across the southeast tip of the site, but are diverted into stormwater drains before reaching Ostrich Bay. Overland runoff could also flow toward the bay, although no direct pathways are evident (Starkes personal communication 1992). Average precipitation is 120 cm each year (URS 1992).

Groundwater near the site is in a surficial aquifer 7 m above sea level and is tidally influenced. Groundwater is estimated to flow eastward at 0.06 to 0.72 cm per day. Discharge of groundwater has been observed at the shoreline in several locations south of Elwood Point (Starkes personal communication 1992).

In the past, the ordnance buildings' floor drain systems were a direct pathway for waste ordnance transport. Where still intact, this system may provide continuing pathways for surface-water runoff and groundwater transport to the bay. A storm drain system also collects stormwater runoff from paved areas. The complete configuration and extent of the floor drains and the storm water systems are unknown. Approximately 23 tile or concrete outfalls discharge directly into Ostrich Bay (URS 1992).

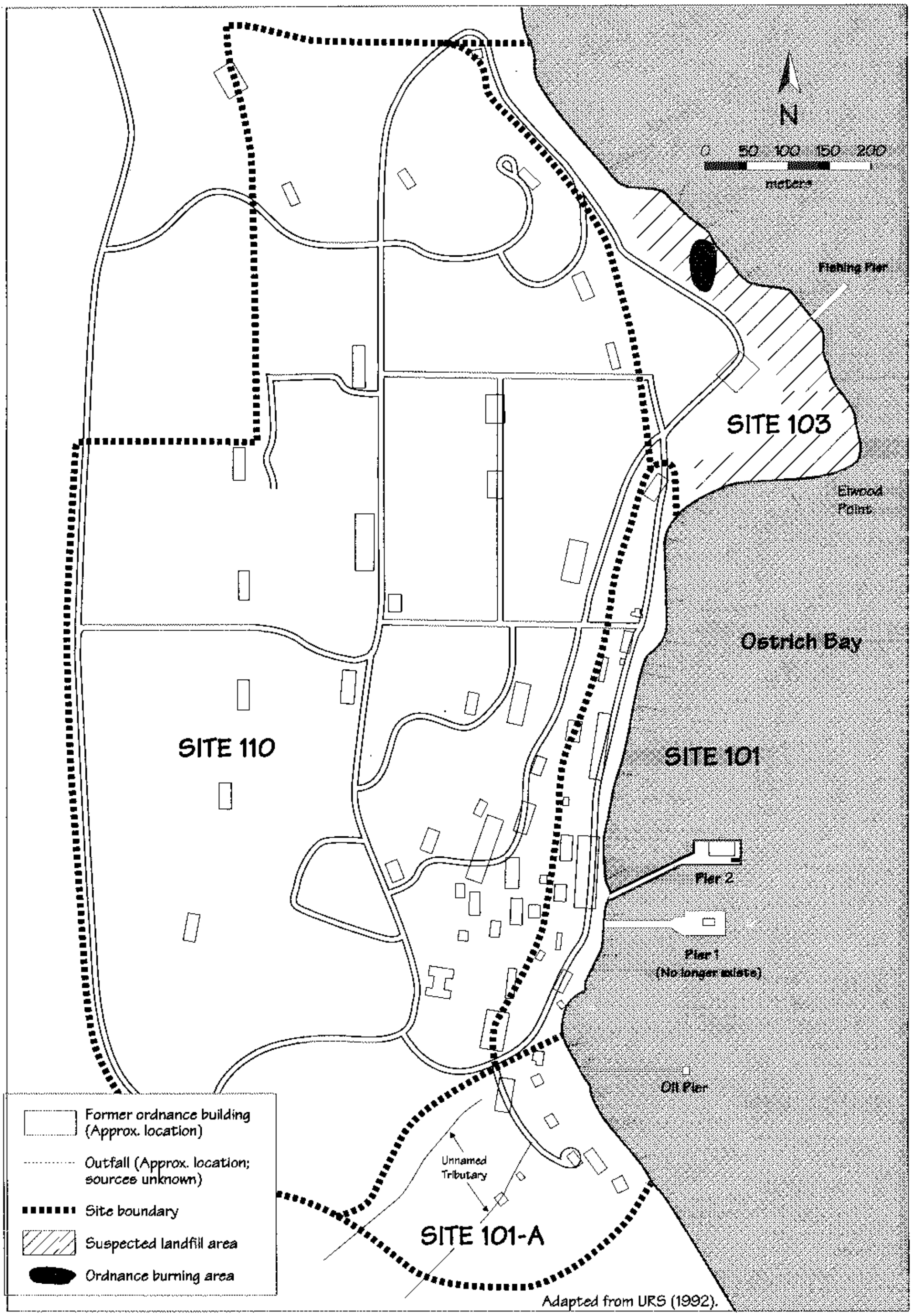

Figure 2. Location of former ordnance buildings at Jackson Park Housing Complex, Bremerton, Washington.

NOAA Trust Habitats and Species

The habitats of concern to NOAA are the near-shore water and sediment of Dyes Inlet and Ostrich Bay. Dyes Inlet is relatively shallow, averaging 13 to 22 m deep, and is surrounded by approximately 43.5 km of shoreline. The substrate is predominantly mud, with areas of mixed sediments (sand, gravel, and mud) along the eastern shore. Salinities range from 24 to 31 ppt and surface water is oxygen-sufficient (average 7.9 mg/l). However, water quality for the inlet is below average because of industrial discharges, non-point source runoff, and high organic inputs from septic systems (Melvin personal communication 1991). Wetland areas within Dyes Inlet are classified primarily as estuarine open water rimmed by narrow fringes of intertidal emergent marsh, estuarine-emergent beach/bar, and estuarine intertidal mudflats (U.S. Fish and Wildlife Service 1980). These wetlands are excellent habitat for fish and invertebrates (Williams et al. 1975).

Dyes Inlet supports diverse, abundant populations of NOAA trust resources near the site (Table 1; U.S. Fish and Wildlife Service 1981; Freymond personal communication 1991; Fyfe personal communication 1991; Washington Department of Fisheries 1991; Zichke personal communications 1991 and 1992). Species of special interest to NOAA are chinook, chum, and coho salmon, as well as steelhead and cutthroat trout. Salmon production in Dyes Inlet is outstanding in spite of the relatively small number of total stream kilometers within the drainage basin (Williams et al. 1975; Zichke personal communication 1992). Dyes Inlet is also excellent bivalve habitat (Fyfe personal communication 1991).

Salmonids use Dyes Inlet as a migratory corridor, a nursery for juveniles, and as a forage area for adults. In general, the stream habitats surrounding Dyes Inlet are highly favored as spawning grounds for salmonids (Williams et al. 1975; Zichke personal communication 1992). The most important spawning habitats include Chico, Clear, Barker, and Mosher creeks. Chico Creek, the largest stream draining into Dyes Inlet, is approximately 4 km north of the site, and supports runs of wild coho and chum salmon, winter steelhead, and cutthroat trout. Chum salmon is the most abundant and widely distributed anadromous species in the area. Cutthroat trout and steelhead are less abundant than the other salmonids.

Several estuarine fish species use Dyes Inlet for spawning, nursery, and adult forage habitat (U.S. Fish and Wildlife Service 1981). Surf smelt spawn over sand/gravel beach bars contiguous to the shoreline of the site (PSWQA 1992). Pacific herring spawn over shallow intertidal beds in Dyes Inlet, approximately 2 km north of the site, and rear their young in surface water near the site (Zichke personal communication 1991; PSWQA 1992). Many other fish species use Dyes Inlet for seasonal nursery and adult forage habitat (Zichke personal communication 1992). The broad intertidal flats and bars of Dyes Inlet also provide excellent habitat for molluscs.

Table 1. NOAA trust resources that use Dyes Inlet, Washington.

Species		Habitat			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS FISH						
Cutthroat trout	*Oncorhynchus clarki*	♦	♦	♦		♦
Steelhead trout	*Oncorhynchus mykiss*	♦	♦	♦		♦
Chum salmon	*Oncorhynchus keta*	♦	♦	♦	♦	♦
Coho salmon	*Oncorhynchus kisutch*	♦	♦	♦	♦	♦
Chinook salmon	*Oncorhynchus tshawytscha*	♦	♦	♦	♦	♦
MARINE FISH						
Sablefish	*Anoplopoma fimbria*			♦	♦	♦
Arrow goby	*Clevelandia ios*	♦	♦	♦		
Pacific herring	*Clupea harengus pallasi*		♦	♦	♦	♦
Shiner perch	*Cymatogaster aggregata*		♦	♦	♦	♦
Striped sea perch	*Embiotoca lateralis*		♦	♦	♦	♦
Buffalo sculpin	*Enophrys bison*		♦	♦		
Pacific cod	*Gadus macrocephalus*		♦		♦	♦
3-spine stickleback	*Gasterosteus aculeatus*	♦	♦	♦		
Silver smelt	*Hypomesus pretiosus*	♦	♦	♦	♦	♦
Rock sole	*Lepidopsetta bilineata*		♦	♦	♦	♦
Pacific staghorn sculpin	*Leptocottus armatus*		♦	♦		
Pacific hake	*Merluccius productus*			♦	♦	♦
Dover sole	*Microstomus pacificus*		♦	♦	♦	♦
Ling cod	*Ophidon elongatus*			♦	♦	♦
English sole	*Parophyrs vetulus*		♦	♦	♦	♦
Starry flounder	*Platichthys stellatus*		♦	♦	♦	♦
Sand sole	*Psettichthys melanostictus*		♦	♦	♦	♦
Cabezon	*Scorpaenichthys marmoratus*		♦	♦		
Rockfish	*Sebastes spp.*		♦	♦		♦
Pile perch	*Rhacochilus vacca*		♦	♦	♦	♦
INVERTEBRATE SPECIES[A,B]						
Dungeness crab	*Cancer magister*		♦	♦		
Red rock crab	*Cancer productus*		♦	♦		
Horse clam	*Clinocardium nuttali*	♦	♦	♦		
Pacific oyster	*Crassostrea gigas*	♦	♦	♦		
Kumamoto oyster	*Crassostrea gigas kumamoto*	♦	♦	♦		
Pacific coast squid	*Loligo opalescens*			♦		
Sea cucumber	*Parastichopus californicus*	♦	♦	♦		
Littleneck clam	*Protothaca staminea*	♦	♦	♦		
Kelp crab	*Pugettia gracilis*		♦	♦		
Butter clam	*Saxidomus giganteus*	♦	♦	♦		
Manila clam	*Venerupis japonica*	♦	♦	♦		

A: There is no commercial harvest of invertebrates in Dyes Inlet because of fecal coliform contamination.
B: Advisory against recreational harvest of shellfish.

Commercial fisheries in Dyes Inlet are limited. Although there were commercial salmon fisheries in Dyes Inlet in the past, none have been scheduled for a number of years. The Suquamish Tribe schedules fall chum harvest in Port Orchard waters, which includes Dyes Inlet. Dyes Inlet also supports native and non-native fisheries for a variety of bottomfish species. Because of resource limitations, however, there has been little commercial harvesting of bottomfish by either fishing group (Zichke personal communication 1992). Sportfishing is said to be light, but quantitative catch data were unavailable. Invertebrate species, including oysters, manila clams, and sea cucumbers, were extensively harvested before Dyes Inlet was closed to shellfishing (Zichke personal communication 1995). In 1968 the Bremerton-Kitsap County Health District issued a health advisory against harvest of shellfish because of potential contamination by fecal coliform bacteria. There is also concern about trace elements and other toxic substances, but such contamination has not been adequately addressed (Washington State Department of Ecology 1991). The Suquamish Tribe also recommends against harvesting shellfish for subsistence. There is also an advisory against eating bottomfish harvested along the western shoreline of Ostrich Bay (Jones personal communication 1993). Signs posted by order of the Commander of Puget Sound Naval Shipyard prohibit the harvest of shellfish because of potential accumulations of toxic chemicals (Starkes personal communication 1992).

Site-Related Contamination

The primary contaminants of concern to NOAA are ordnance compounds and their precursors and degradation products (hereafter referred to collectively as "ordnance compounds"). These compounds include nitrobenzene; 1,3-dinitrobenzene; 1,3,5-trinitrobenzene; 3,3'-dichlorobenzidine; 2,4-dinitrotoluene; 2,6-dinitrotoluene; 2,4,6-trinitrotoluene (TNT); picric acid, trinitrophenylmethylnitramine (Tetryl); hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX); and propylene glycol dinitrate (Otto fuel). Trace elements are of secondary concern.

During a 1991-92 RI/FS, groundwater, surface water, soil, sediment, and crab and bivalve tissues were sampled at the site and nearby in Ostrich Bay. Crab and bivalve tissues and sediment samples from Chico Bay in Dyes Inlet and Semiahmoo Bay in northern Puget Sound were collected as reference samples. Only concentrations of contaminants that exceeded screening levels identified in the RI/FS were reported (URS 1992).

To identify substances that might pose a threat to resources of concern to NOAA, the concentrations of contaminants in water samples were compared to marine AWQC for the protection of aquatic organisms for those substances for which such criteria have been developed (U.S. EPA 1993). Concentrations of contaminants in sediments were compared to ERL and ERM guidelines (Long and MacDonald 1992).

Ordnance compounds were present in all media tested (Table 2). Most of the soil contamination was observed at Sites 101 and 101A. More ordnance compounds were detected in surface water offshore of the site and at higher concentrations than were detected in groundwater. Many of the ordnance compounds were also detected in sediments offshore of the site. However, the concentrations of some of these compounds were similar or higher in samples from the reference areas. Ordnance compounds were detected in bivalve and crab tissue samples offshore of the site

Table 2. Concentrations of contaminants of concern in soil, sediment, groundwater, and surface water near Jackson Park Housing Complex (URS 1992).

Contaminants	Site Soil (mg/kg)	Site Sediment (mg/kg)	ERL[a] (mg/kg)	ERM[a] (mg/kg)	Site Groundwater (μg/l)	Surface Water (μg/l)	AWQC[b] Marine chronic (μg/l)
INORGANIC SUBSTANCES							
Trace Elements							
Antimony	ND	26,000	NA	NA	ND	ND	500/p
Arsenic	ND	47	8.2	70	ND	ND	36
Cadmium	ND	16	1.2	9.6	ND	ND	9.3
Chromium	ND	110	81	370	ND	ND	50
Lead	ND	3,600	46.7	218	ND	ND	8.5
Mercury	ND	0.91	0.15	0.71	ND	ND	0.025
Nickel	ND	85	20.9	51.6	ND	ND	8.3
Silver	ND	9.5	1	3.7	ND	ND	2.3
Zinc	ND	230	150	410	ND	ND	86
Cyanide	ND	5.1	NA	NA	ND	ND	1.0+
ORGANIC COMPOUNDS							
Bis(2-ethylhexyl)phthalate[c]		170[c]	NA	NA	ND	ND	NA
Aroclor 1254	1.7	ND	NA	NA	ND	ND	NA
Ordnance Compounds							
Nitrobenzene	0.16	ND	NA	NA	0.29	0.3	6,680+
1,3-Dinitrobenzene	ND	0.051	NA	NA	ND	ND	NA
1,3,5-Trinitrobenzene	ND	0.49	NA	NA	0.13	0.082	NA
2,4-Dinitrotoluene	0.082	ND	NA	NA	0.049	23	370*
2,6-Dinitrotoluene	0.033	ND	NA	NA	ND	0.01	NA
2,4,6-Trinitrotoluene	0.04	0.055	NA	NA	ND	ND	NA
RDX	0.035	ND	NA	NA	ND	0.32	NA
Picric acid	ND	0.92	NA	NA	ND	ND	NA
Tetryl	ND	0.99	NA	NA	ND	2.53	NA
Otto fuel	ND	ND	NA	NA	ND	ND	NA

a: Effects range-low and Effects range-median (Long and MacDonald 1992).
b: Ambient water quality criteria (U.S. EPA 1993).
c: Concentration normalized to organic carbon and expressed as mg/kg organic carbon.
NA: Not available.
ND: Not detected or not detected above screening levels (URS 1992).
/p: Value is proposed criterion.
+: Value is marine acute criterion.
*: Value is Lowest Observed Effects Level (LOEL).

at concentrations that were similar to those observed at the reference stations (URS 1992).

Only concentrations of trace elements in on-site soils that exceeded Department of Defense screening guidelines were reported (URS 1992). Raw data reports were not available. Therefore, no determination could be made whether soil is a potential source of trace element contamination that could injure trustee resources. However, activities at other ordnance-production facilities have resulted in trace element contamination (Shineldecker 1992). Concentrations of trace elements in surface water were lower than applicable AWQC guidelines. However, the concentrations of most of the trace elements in the sediments of Ostrich Bay exceeded ERL guidelines (Table 2). Cadmium, lead, mercury, nickel, and silver concentrations also exceeded ERM guidelines but similarly high concentrations were observed in the sediments from reference areas.

Summary

Past activities at Jackson Park Housing Complex included ordnance production, demilling, storage, and waste disposal. Ordnance residues in the form of wastewater were released via floor drainage systems into Ostrich Bay. Ordnance compounds were detected in soil, surface water, groundwater, sediment, and biological tissues. Concentrations of cadmium, lead, mercury, nickel, and silver in sediments exceeded ERM concentrations. Ostrich Bay, an embayment of Dyes Inlet, provides habitat for several salmonid species that support tribal as well as commercial harvests. Dyes Inlet is also known to be a productive area for shellfish.

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10

McCormick & Baxter Creosoting Company

Portland, Oregon
CERCLIS #ORD009020603

Site Exposure Potential

The McCormick & Baxter Creosoting Company site occupies approximately 23 hectares in a highly industrialized area of Portland, Oregon (Figure 1). The site is situated on the bank of the Willamette River, approximately 11.3 km upstream from the confluence of the Willamette and Columbia rivers. The Columbia River enters the Pacific Ocean 160 km downstream from the confluence of the Willamette River.

Wood products were treated at the site from 1944 to 1991. The chemicals used for pressure-treating included creosote, PCP, chrome, ammoniacal copper arsenate, ammoniacal copper zinc arsenate, and Cellon (PCP, liquid butane, and isopropyl ether). Wood was treated in a central processing area that had four retorts (Figure 2). Various mixtures of creosote, PCP, and oil were stored in a tank farm next to the central processing area. Between 1950 and 1965, waste oil containing creosote and PCP was used to stabilize soils on the site. Between 1945 and 1971, process wastewater and non-contact cooling water were discharged directly to the Willamette River via four outfalls, while boiler water, stormwater, and oily wastes were directed or discharged to a former waste disposal trench in the southern portion of the site. In 1971, an evaporator was installed to treat process wastewaters.

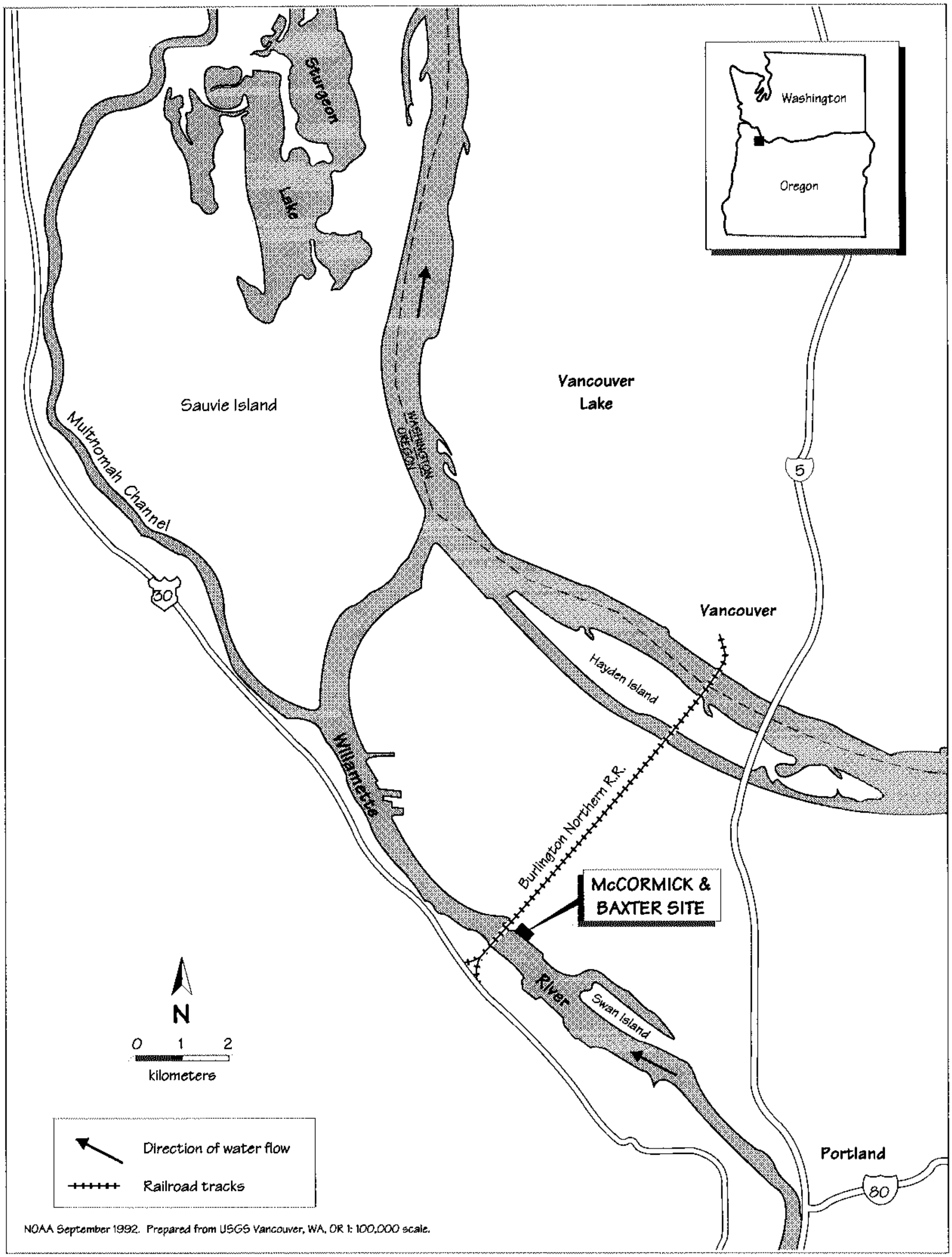

Figure 1. The McCormick & Baxter site in Portland, Oregon.

Before 1968, residues from site processes were disposed at an unknown off-site location. From 1968 to 1971, processing wastes were disposed in the former waste disposal area. Between 1972 and 1978, the residues were stored in metal containers and accumulated in the former waste disposal area. After 1978, wastes were shipped to an off-site hazardous waste disposal facility. Numerous areas of contamination have been observed on the site, primarily in the Central Process Area, Tank Farm, and at the Former Waste Disposal Area (PTI 1992).

Groundwater migration and surface water runoff discharged via outfalls to the Willamette River are the potential pathways of contaminant transport from the site to NOAA trust resources and associated habitats. Groundwater beneath the site occurs in three aquifers: an unconfined water table aquifer found between 6 and 9 m bgs, a semi-confined, intermediate aquifer between 12 and 16 m bgs, and a confined, deep aquifer below 45 m. Silt-sand aquitards separate the three aquifers, although the water table and intermediate aquifers are continuous in some areas beneath the site. Groundwater in the water-table aquifer generally flows to the southwest and discharges into the Willamette River. Surface water runoff from the site drains to the Willamette River through a series of drainage ditches, storm drains, and culverts that lead to four outfalls (Figure 2). Only Outfall 002 is authorized for stormwater discharge under a NPDES permit. The site is outside the one hundred-year floodplain (PTI 1992).

NOAA Trust Habitats and Species

The surface water and associated bottom substrates of the Willamette River are the habitats of most concern to NOAA. Anadromous fish species that use the Willamette River are the resources of concern to NOAA (Table 1). Surface water near the site is tidal fresh water (Ward personal communication 1992). Water averages 12 to 14 m deep near the site, with a maximum depth of 24 m. Habitat in the Willamette River near the site has been altered to accommodate urban development and a growing shipping industry. Artificial structures such as piers and wharves have changed the natural shoreline to riprap, bulkheads, and sand-beached lagoons. The river bottom is composed of silt and sand, with steep sides due to dredging (PTI 1992).

Five salmonid species inhabit the river near the site during different portions of the year. These salmonids include chinook (two races, spring and fall), coho, and sockeye, steelhead trout (two races, winter and summer), and cutthroat trout. Salmonids use habitat near the site as a migratory corridor to upstream spawning grounds and as a nursery for juveniles. In general, chinook and steelhead populations are the largest and most widespread of the salmonids in the river. There are few cutthroat trout in the Willamette River (Bennett and Foster 1991; Melcher personal communication 1994).

Other anadromous fish in the Willamette River near the site include American shad and white

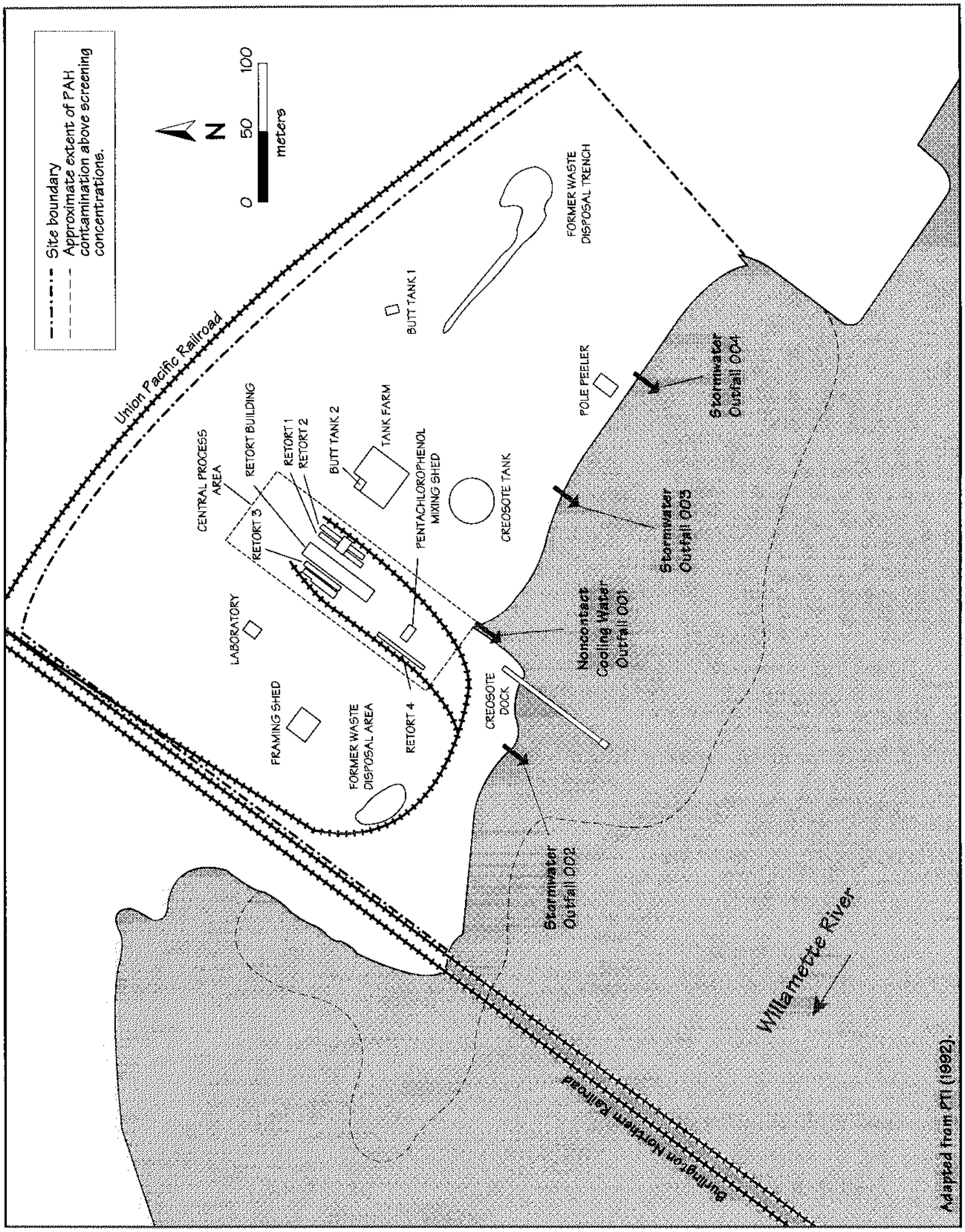

Figure 2. The McCormick & Baxter site in Portland, Oregon and approximate area of sediment contamination.

Table 1. Anadromous fish species in the Willamette River near the McCormick & Baxter site (Bennett and Foster 1991; Farr et al. 1991; Ward personal communication 1992; Melcher personal communication 1994).

Anadromous Species		Habitat			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
White sturgeon	*Acipenser transmontanus*		♦	♦		♦
American shad	*Alosa sapidissima*		♦	♦		♦
Cutthroat trout	*Oncorhynchus clarki*					♦
Coho salmon	*Oncorhynchus kisutch*		♦			♦
Steelhead trout[1]	*Oncorhynchus mykiss*		♦			♦
Sockeye salmon	*Oncorhynchus nerka*		♦			♦
Chinook salmon[1]	*Oncorhynchus tshawytscha*		♦			♦

[1]Species are supplemented by a stocking program.

sturgeon, both of which are plentiful (Bennett and Foster 1991; Melcher personal communication 1994). American shad spawn about 25 km upstream of the site, but use areas next to the site for adult migration and foraging, and for juvenile rearing grounds (Melcher personal communication 1994). White sturgeon spawning in the Willamette River has not been documented, but it is suspected that they spawn in the same location as American shad. White sturgeon are known to forage freely throughout the river (Melcher personal communication 1994).

Chinook and steelhead runs are both supplemented by hatchery stocks. Five large hatcheries produce approximately 5 million smolt-size spring chinook for release into the Willamette River each year, plus additional fingerling salmon to seed under-used reservoir and tributary streams. Fall chinook runs are supplemented by the addition of 5 to 7 million smolts each year. Steelhead runs have been supplemented by hatchery stocks since the 1960s. Since 1991 approximately 565,000 winter and 750,000 summer steelhead smolts have been released each year in the Willamette River basin (Massey personal communications 1992, 1994).

There are no commercial fisheries for anadromous salmonids on the Willamette River, although the Columbia River supports a valuable commercial fishery. Due to sharp declines in stocks, stock preservation activities, competing fishing gears, and conflicting uses (e.g., hydropower and shipping), commercial fisheries are highly regulated in the Columbia River. Recreational fishing is extremely popular throughout the lower Willamette basin. Species most desired are spring chinook, steelhead, coho, American shad, and white sturgeon (Haxton personal communication 1991; Melcher personal communication 1994). Spring chinook contribute substantially to the mainstem Columbia River sport fishery and consistently support the largest recreational fishery in the lower Willamette River.

Site-Related Contamination

The primary contaminants of concern to NOAA are several PAHs associated with creosote, PCP, polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and trace elements. These substances were detected at elevated concentrations in the soils and groundwater on the site, in surface water discharging to the Willamette River, and within the sediments of the Willamette River. In addition, elevated concentrations of the above contaminants have been detected in floating and sinking product layers in both the shallow and intermediate aquifers beneath the site (PTI 1992). The maximum concentrations of contaminants detected in various media types are presented in Tables 2 and 3 along with their respective screening guidelines.

Sources of PAHs on the site were primarily associated with the Central Process Area, the Former Waste Disposal Area, and the Tank Farm. Concentrations of total PAHs consistently exceeded 1,000 mg/kg in surface soils collected from these areas. In the product layers, concentrations of PAHs were at percent concentrations, well above groundwater screening concentrations. In the dissolved phase of groundwater, PAH concentrations were also very high, generally only an order of magnitude lower than the concentrations observed in product layers. PAHs were not observed in water samples collected from the stormwater outfalls (PTI 1992). All of the PAH compounds found on the site were detected in river sediment at concentrations exceeding screening guidelines. PAH-contaminated sediments extend along the entire shoreline of the site and into an embayment northwest of the site. The most contaminated sediments were found near the creosote dock and in the embayment. Preliminary results of sediment core studies indicate that there are PAHs in sediments above screening concentrations as deep as 2 m below the sediment surface (PTI 1992).

PCP was widespread in surface and subsurface soils, with a distribution similar to the PAHs. Elevated concentrations in surface soils were measured in the Central Process Area with the highest concentrations near Retort 4, in which PCP was the primary substance used. PCP was also a substantial component of the product layer observed within the groundwater. In water samples from the outfalls, PCP was detected at concentrations exceeding screening guidelines in six of seven samples collected. Relatively low concentrations of PCP were observed in river sediment compared to the PAHs. However, concentrations exceeding the screening guideline were observed in sediment downgradient of the Central Process Area, around the creosote dock, and downgradient of the Former Waste Disposal Area (PTI 1992).

Table 2. Maximum concentrations (µg/l) of contaminants of concern in groundwater, product layers, and outfall surface water compared with freshwater chronic AWQC.

Contaminant	Groundwater	Groundwater Product Layers	Outfalls	AWQC[1]
ORGANIC COMPOUNDS				
PAHs				
Naphthalene	2,400,000	90,000,000	NA	620*
Acenaphthalene	150,000	490,000	NA	520*
Acenaphthene	2,000,000	30,000,000	NA	21*
Fluorene	1,800,000	36,000,000	NA	NA
Phenanthrene	3,900,000	88,000,000	NA	NA
Anthracene	620,000	8,200,000	NA	NA
Fluoranthene	2,000,000	32,000,000	4	NA
Pyrene	1,100,000	30,000,000	2	NA
Chrysene	190,000	4,500,000	NA	NA
Benzofluoranthenes	160,000	1,700,000	NA	NA
Benzo(a)pyrene	100,000	100,000	NA	NA
Benzo(e)pyrene	5,300	100,000	NA	NA
Other Organic Compounds				
Pentachlorophenol	1,200,000	8,200,000	1,700	NA
PCDDs/PCDFs[2]	NA	0.20	0.24	<0.00001
TRACE ELEMENTS				
Arsenic	9,000	NT	7,600	190
Chromium	12,000	NT	780	210
Chromium $^{+6}$	120	NT	19	11
Copper	5,400	NT	15,000	12+
Zinc	260,000	NT	8,200	110+

1: Ambient water quality criteria for the protection of aquatic organisms. Freshwater chronic criteria presented (U.S. EPA 1993).
2: Toxicity equivalent concentrations of 2,3,7,8-TCDD.
NA: Screening guidelines not available.
NT: Not tested.
*: Value is Lowest Observed Effects Level (LOEL).
+: Hardness-dependent criteria (100 mg/l $CaCO_3$ used).

Contamination by PCDDs and PCDFs was not as widespread as by PAHs and PCP. These substances appeared at the most contaminated areas, particularly those with the highest concentrations of PCP. However, since analyses for PCDDs and PCDFs were not conducted in surface soils away from the Central Process Area, it is not known how seriously other areas are contaminated. PCDDs and PCDFs were observed in the product layer collected from the shallow aquifer downgradient of the Central Process Area near the river and the Former Waste Disposal Area in

Table 3. Maximum concentrations of contaminants of concern detected in soil and sediment from the McCormick & Baxter site compared with screening guidelines.

	Soil (mg/kg)		Sediment (mg/kg)	
Contaminant	On-site Surface Soil	Average U.S. Soil[1]	Willamette River	ERL[2]
ORGANIC COMPOUNDS				
PAHs				
Naphthalene	42	NA	3,500	0.16
Acenaphthalene	50	NA	17	1.3
Acenaphthene	940	NA	1,300	0.016
Fluorene	1,300	NA	1,100	0.019
Phenanthrene	4,900	NA	1,900	0.29
Anthracene	2,600	NA	290	0.085
Fluoranthene	2,900	NA	960	0.60
Pyrene	1,600	NA	610	0.67
Chrysene	1,900	NA	170	0.38
Benzofluoranthenes	1,000	NA	170	3.2
Benzo(a)pyrene	210	NA	58	0.43
Benzo(e)pyrene	620	NA	50	NA
Other Organic Compounds				
Pentachlorophenol	4,800	NA	7.2	0.69*
CDDs/CDFs[3]	0.38	NA	0.0027	NA
TRACE ELEMENTS				
Arsenic	5,100	5.0	18	8.2
Chromium	720	100	48	81
Chromium +6	11	NA	0.99	NA
Copper	3,600	30	330	34
Zinc	4,200	50	350	150

1: Lindsay (1979).
2: Effects range-low; the concentration representing the lowest 10-percentile value for the data in which effects were observed or predicted in studies compiled by Long and MacDonald (1992).
3: Toxicity equivalent concentrations of 2,3,7,8-TCDD.
NA: Screening guidelines not available.
*: ERL concentration not available; the concentration presented is the maximum Apparent Effects Threshold (AET; PTI 1988).

samples that contained the highest concentrations of PCP. Concentrations in the product layers exceeded groundwater screening concentrations by up to three orders of magnitude. In water samples from three outfalls, PCDDs and PCDFs exceeded screening guidelines. The highest concentrations of PCDDs and PCDFs detected in sediment next to the site were found near the creosote dock and downgradient of the former Waste Disposal Area (PTI 1992).

Elevated concentrations of arsenic, chromium, copper, and zinc were generally limited to the Central Process Area and Tank Farm. The highest concentrations of trace elements in soil were observed in surface samples collected from the Central Process Area where ammoniacal copper zinc arsenate was used. Concentrations of trace elements in groundwater greatly exceeded screening concentrations in the Central Process Area, downgradient near the river, and beneath the Former Waste Disposal Area. Trace elements exceeded screening guidelines in water samples collected from Outfalls 002 and 003. In river sediments, copper and zinc were detected at concentrations exceeding their screening guidelines at three of the 48 stations that were sampled. Two of these stations were upstream of the Central Process Area and one was downstream of the railroad bridge (PTI 1992).

Bioassays using the freshwater amphipod *Hyalella azteca* and the Microtox test were conducted with sediments collected from the Willamette River next to the site. Significant adverse effects were observed with both tests. Stations where bioassays showed toxicity to test species were in an area next to the site extending from the Central Process Area to below the railroad bridge. These data indicate the possibility that other benthic organisms, some of which may be ecologically important to NOAA trust resources, may be adversely impacted in areas of the river near the site. In addition, bioaccumulation and histopathology studies indicated that the PAHs discharged from the site are bioavailable and that uptake is occurring to resident freshwater organisms. PCDDs and PCDFs did not appear to be as available (PTI 1992).

Summary

The primary contaminants of concern are PAHs, PCP, PCDDs, PCDFs, and trace elements. These contaminants were detected at elevated concentrations in environmental media collected throughout the site. Data indicate that these contaminants have migrated off-site to trust resource habitat in the Willamette River. In particular, PAHs were detected in sediment collected from the river at concentrations greatly exceeding screening guidelines for the protection of aquatic life. These sediments were toxic to aquatic organisms in laboratory bioassays. Contamination in the Willamette River near the site poses a threat to populations of anadromous fish that are NOAA trust resources, including five salmonid species, American shad, and white sturgeon.

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